European Commission

JRC TECHNICAL REPORTS

Mapping EU investments in ICT - description of an online tool and initial observations

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2016

Joint Research Centre

EUR 27983 EN

This publication is a Technical report by the Joint Research Centre, the European Commission's in-house science service. It aims to provide evidence-based scientific support to the European policy-making process. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

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JRC Science Hub
https://ec.europa.eu/jrc

JRC102233

EUR 27983 EN

ISBN 978-92-79-59748-0

ISSN 1831-9424

doi:10.2791/963062

How to cite: Sörvik J. and Kleibrink A. (2016), Mapping EU investments in ICT - description of an online tool and initial observations; Luxembourg (Luxembourg): Publications Office of the European Union, EUR 27983 EN, doi: 10.2791/963062

Table of contents

Abstract

Information and Communication Technologies (ICTs) are major drivers of social and economic change. They are also one of the key Thematic Objectives (TOs) in the European Structural and Investment Fund (ESIF). The aim of these funds is to strengthen economic, social and territorial cohesion within the European Union. ICTs not only constitute an important sector themselves, but are also an important enabler of other sectors. This is why, analysis of ESIF data on planned ICT investments show EUR 12.2 billion encoded in the dedicated TO, but when ICT categories in other TOs are included, this amount almost doubles, to EUR 21.4 billion.

Finding out more about the ICT investment plans of EU Member States and regions is not always a straightforward process. The available data for ESIF are structured in TOs and Categories of Intervention (CoIs); however, ICT investment often funds activities beyond the dedicated TOs and CoIs. To obtain a better picture of planned ICT investments, the European Commission Directorate General for Communications Networks, Content & Technology (DG CONNECT) and the JRC Institute for Prospective Technological Studies (JRC-IPTS) have developed an online tool to display planned ICT investment data on a regional basis. This tool will help EC officials, national and regional policymakers working on ICT issues, and beneficiaries of ESIF, to understand what kind of ICT activities are being planned in Europe.

The ICT monitoring tool can be searched using a number of predefined filters, or searches of TOs and CoIs can be customised. The tool also contains a database of keywords built up by a semantic search for keywords in Operational Programmes (OPs). This database allows the user to identify OPs that mention a number of ICT activities more frequently than others, and to identify if a specific topic is mentioned in a region at all. The data set included in the tool is based on an in-depth study of individual OPs, as well as on aggregated data sets.

When studying the available data, we found that Thematic Objective 2 (TO2) does not account for all planned ESIF investments in ICT. Using a broader set of CoIs, planned spending on ICT almost doubled, from 3.8 % to around 6.6 % of the combined total of European Regional Development Funds (ERDF), the European Social Fund (ESF), Cohesion Funds (CF) and European Agricultural Fund for Rural Development (EAFRD). However, it is likely that even this method fails to capture all planned investments, as respondents to our study indicated that substantial investments in ICT will be allocated to other categories, which would increase ESIF investments in ICT to EUR 35.5 billion. However, this estimate is not currently included in the tool, as the methods of estimating investments are not judged to be adequate. This range of different amounts of investment reflects the dual nature of ICT as an important sector and activity in itself, as well as an enabling technology in other public and private activities.

Taking the moderate estimates, the EU Member States that plan by far the largest investments in ICT in absolute terms are Poland, Italy and Spain; the regions with the largest planned investments are Campania (IT), Sicilia (IT), Andalucía (ES), Slaskie (PL) and Puglia (IT). For example, the region of Campania plans to invest more ESIF in ICT than the whole of Germany. The greatest investments will be in broadband and ICT infrastructures (EUR 6.9 billion), e-Inclusion and digital skills (EUR 3.9 billion), e-Government (EUR 3.4 billion), and smart cities and smart grids (EUR 3.1 billion).

To get a more in-depth view of future plans, we carried out a keyword search of ESIF data. Among the most frequently mentioned keywords are ICT innovation, e-Inclusion, broadband and digital content. This is partly because these keywords are broad and all-encompassing, but the findings also reflect the ambition of many regions to invest in ICT-based innovation activities. Quite substantial ICT investments will go to ICT-based innovation and digital content, but this will be listed under CoIs related to support of small and medium-sized enterprises (SMEs) and research and innovation, rather than the core CoIs for planned ICT investments.

1. Introduction

The objective of the European Structural and Investment Fund (ESIF) is to strengthen economic, social and territorial cohesion within the European Union. ESIF is structured through Partnership Agreements (PAs) between the European Commission (EC) and individual Member States (MSs). One of the prioritised Thematic Objectives (TOs) in ESIF for the upcoming programme period is Information and Communication Technologies (ICT). There are great expectations that ICT will be an enabler of structural change that will improve European societies and enhance their economic competitiveness.

Finding out more about the ICT investment plans of EU regions is not always a straightforward process. ICT is important as a sector in itself, is an integral part of emerging related sectors (e.g. e-Health), and is also a means to enable other activities. The activities carried out with financing from the ESIF often have multiple aims, so, when the OPs are programmed, it is not easy to encode ICT-related activities within the assigned categories. The financial data in OPs are structured into Categories of Intervention (CoIs), TOs and priority areas; there is also descriptive text on the priority areas, as well as text on what kind of actions are to be supported.

In the guidance material for regions and MSs to support their writing of OPs, it is indicated that planned ICT activities shall be coded primarily under Thematic Objective 2 (TO2). Furthermore, there are a number of specific CoIs that are connected to these ICT interventions. However, ICT is multi-dimensional and planned ICT investments are also coded under other CoIs and TOs. In order to understand where regions and MSs plan to invest in ICT, it is not sufficient to look only in TO2 – a broader search is required.

Previous tools intended to analyse ICT investments under the ESIF have been unable to distinguish different ICT themes or the activities of different regions. Data have been available only at national level and on higher aggregations of categories. To overcome this and to create a tool that would help stakeholders interested in detailed information about how EU regions and MSs plan to invest in different ICT themes, the European Commission Directorate General for Communications Networks, Content & Technology (DG CONNECT) and the JRC Institute for Prospective Technological Studies (JRC-IPTS) have developed a monitoring tool to analyse planned ICT investments under the ESIF.

This report outlines the work by JRC-IPTS in close cooperation with DG CONNECT that has led to the development of an online tool that allows users to identify planned ICT investments under the ESIF.[1] The results of the search are presented as a list and also on a map showing the data on a regional level.[2]

The tool allows the user to search three broad dimensions of ESIF data:

- amounts: planned investments expressed as TOs and CoIs;
- keywords: frequency of keywords in OPs;
- financial forms: amounts of planned investments through financial instruments.

The user can search using predefined filters or can customise searches by selecting their own categories.

The development of this tool has been carried out in a number of steps, including in-depth studies of OPs, keyword searches, analysis of the aggregated statistical material and interviews with DG REGIO and DG CONNECT staff, as well as with regional and

[1] Investments from ERDF, CF, ESF, Youth Employment Initiative (YEI) and EAFRD are analysed.

[2] The data in the tool come from the SFC2014 database and the reports derived using the business objects/Infoview software. Data from national, multi-regional and transnational cooperation programmes are broken down at regional level, by taking their population size into account. Data depicted are thus estimations of potential investments and do not reflect final investment figures.

national penholders who have written the OPs. This has established which CoIs are relevant for identifying planned ICT investments. The work has also been informative on how to carry out a systematised keyword search of OPs. The data set generated gives a more in-depth view of planned ICT investments in MSs and regions, and at the same time has given an overview, at EU level, of these planned investments.

This report describes how the tool has been designed and implemented, and highlights preliminary findings as well as suggesting potential future developments.

2. Work process

JRC-IPTS has explored four main approaches in order to better understand how regions and MSs describe their planned ICT investments in ESIF OPs and to guide the development of the monitoring tool in terms of mapping and visualisation.

The work began as a pilot with the aim of identifying how a monitoring tool could be designed. The initial step involved five case studies, in which the researchers explored the structure of OPs to identify which parts and, in particular, which CoIs are relevant to understand planned ICT investments. The objective was also to explore whether it would be possible to use keyword searches to better quantify financial allocations of different ICT areas. While this process was being initiated, there was also a request to develop a visualisation tool to illustrate how this could be done in practice.

In subsequent steps the tool was gradually evolved through interactions with users, and through the different analytical steps described below. This informed the decision regarding which data to include, how to organise the data and how to make the data available to the users through the online tool. The process has been evolutionary, and there has been overlap in the development steps, but the process has led to the development of an online tool, with additions of data sets and functionalities through interaction with potential users.

The main steps of the process have been:

1. case studies of five national and regional OPs with initial keyword searches of several OPs;
2. analyses of the aggregated ESIF data extracted from the Infoview/SFC2014 database;[3]
3. keyword searches of actions to be supported through the ESIF;
4. a quality review of the data.

2.1 Case studies

The work process began with a detailed analysis of the structure of five OPs. The case study OPs were selected on the basis that they were representative of different potential OP structures in EU MSs, as well as having planned substantial ESIF investments. The OPs were a mix of national and regional OPs (the Andalusian Growth & Jobs OP, the Slovakian Integrated Infrastructure OP, the Slovakian Research and Innovation OP, the Digital Poland OP and the Croatian Competitiveness and Cohesion OP).

The main aim was to explore how ESIF data can be used to monitor planned ICT investments, using both structured financial data along the standardised CoIs and other information categories. A secondary aim was to explore opportunities to use keywords in a more specific analysis of how public authorities intend to invest in ICT and, possibly, to estimate the size of planned financial investments in different areas of activity, by connecting financial posts and keywords in the text.

There was also a strong interest in using the region as the unit of analysis in order to aggregate data from different types of programme and gather a better understanding of where in Europe different kinds of activities will take place and where the greatest investments will take place. It became part of the assignment to explore how data from non-regional levels could be attributed to regions.

Through this analysis, JRC-IPTS could identify a number of options for developing a monitoring tool and for visualising relevant investment data.

[3] The SFC platform from which the data were retrieved is a management tool for ESIF managing authorities (MAs) at national and regional level and the four ESIF managing DGs (REGIO, EMPL, AGRI, MARE). The data are entered by MAs, verified by DGs and, if needed, corrected by the MA. Infoview is a tool to visualise the data for ERDF, ESF, CF and YEI investments, as expressed in their PAs and OPs.

The case studies helped in identifying which data categories should be included in the monitoring tool. There is substantial investment in TO2, both in ICT as a horizontal enabler and in vertical ICT specialisations and the case studies also confirmed that large proportions of ICT investments are frequently encoded in other TOs. The major areas of investment related to ICT identified in the OPs included broadband, business/innovation support, e-Infrastructure, e-Government, open data, digital trust, digital skills, e-Inclusion, e-Education and e-Health.

The enabling aspect was seen in the prevalence of planned ICT investments in other domains, such as research and innovation (R&I) (TO1), small and medium-sized enterprise (SME) support (TO3) and education (TO10). There were also more direct sectorial investments such as investments in ICT-driven multimodal transport systems and smart grids in TO4 and TO7. Broadly outlined ICT-relevant investments in the other TOs referred to activities such as:

- TO1: key enabling technologies (KETs), e-Infrastructures, horizontal support of technology transfer and ICT, research information system/access to databases; as well as different forms of ICT-based smart specialisations (e.g. ICT and tourism);
- TO3: SME and business support to increase digital businesses, ICT uptake by SMEs and e-Business;
- TO4: smart grids/metering/energy;
- TO7: transport, intelligent and inter-modal transport systems, smart cities/smart mobility;
- TO10: e-Schools.

The study also showed that in order to track the planned investments in ICT through the ESIF, it is necessary to look at both TOs and different CoIs. A review of the documents enabled the list of ICT-related CoIs to be broken down into core and non-core CoIs, all of which were ICT relevant (see Appendix 1 for final list).

These categories have been followed up in the studies exploring the potential uses of the Infoview/SFC2014 database (see next section). The initial list of non-core CoIs was longer than the final one, whereas the number of core CoIs remained constant. From reviewing the OPs, it was apparent that there will be many investments in activities that relate to ICT but which cannot easily be tracked and quantified outside the core categories.

With regard to the possibilities of a keyword search, it was found not to be possible to connect specific keywords to financial amounts. A keyword search can indicate areas where there will be investment, but cannot connect this directly to any financial amounts. The OPs include different chapters describing the planned activities in different investment priority areas; these also contain a section describing which actions to be supported along with tables detailing the amounts to be invested in different CoIs. However, these sections mention many actions (in some cases up to 40 different objectives), as well as many different CoIs, and there are no direct links between actions and amounts. This makes it impossible to connect keywords to specific financial data.

The analysis also revealed that for a keyword search to identify activities that regions and MSs plan to invest in, the most relevant area for text searches is 'Actions to be supported'. Regions and MSs list under this heading the activities they plan to invest in using the ESIF. Furthermore, these data can be extracted from SFC2014 in a structured way, allowing for a tool to search all OPs in a similar fashion. Moreover, to identify important investment areas, it will be important to carry out cross-searches, for example to look for ICT and SMEs, as a search for SMEs alone is not relevant. However, when cross-searching words, it is appropriate to search in a sentence and/or paragraph; a cross-search in an entire page is too crude.

Another finding was that a keyword search has to be done in the original language, since most OPs are in original languages and machine translations are not sufficiently

accurate. At the same time, many countries use the English terms (e.g. smart city), so OPs should be searched in both the original language and English.

The case studies also allowed us to identify possible keywords for an automated keyword search. They helped in developing keyword lists for Polish, Spanish and Slovak, and provided additional words for the English list that we used in the first steps of the keyword search process.

2.2 Aggregated ESIF data analysis

In the next step, JRC-IPTS analysed data from the Infoview/SFC2014 database. This database provides information on how regions and MSs plan to invest ESIF; of main interest were the relevant TOs and CoIs.

The analysis began by looking at the list of CoIs that was generated in the case studies. These categories were explored by looking at the amount of investment going into them, and determining how much was coded in the CoI under TO2, or under other TOs. From this process a list of core CoIs emerged with typical ICT-related objectives, and also a list of non-core CoIs that were still relevant for ICT. These lists also formed a basis for discussion with staff from DG REGIO[4] and DG CONNECT[5] regarding which CoIs they use in analysing planned ICT investments.

It was decided to work with these core and non-core, but still relevant, CoIs, as these were deemed relevant for DG CONNECT's monitoring purposes. The core categories were those clearly dedicated to ICT and the non-core subset was chosen because they included planned investments related to ICT that fell under TO2 (ICT). We also discussed whether or not to include additional CoIs that had been identified in the case studies, and if CoIs related to TO1 and TO3 should be included. These last two TOs are quite strongly related to Smart Specialisation and in reviewing Smart Specialisation Strategies (RIS3), the S3 Platform had identified that around 10 % of the areas selected for investments were related to ICT (Sörvik and Kleibrink, 2015).[6] However, it was deemed too uncertain and speculative to attempt this kind of estimation and include parts of CoIs belonging to these TOs. For the entire list of core and non-core CoIs, see Appendix 1.

Later in the process, we created a measure that would be the best estimate of overall planned ICT investments in ESIF. This grouping is called 'All ICT-related Categories of Intervention' and includes the core CoIs in all TOs and non-core CoIs under TO2, as well as data on the European Agricultural Fund for Rural Development (EAFRD).

At the same time, DG CONNECT staff requested that a number of CoIs be considered for inclusion in the tool; these were CoIs covering areas that are relevant for ICT-related policy processes and could include ICT components, such as voucher programmes, and skills, training and learning, even though a search in the Infoview database and the case studies do not indicate a strong connection to TO2. These categories have been included in the online tool's data set, but are not included in the core or non-core CoIs.

The data for the tool are mainly drawn from the European Regional Development Funds (ERDF), the European Social Fund (ESF), the European Agricultural Fund for Rural Development (EAFRD), some Cohesion Funds (CF) and the Youth Employment Initiative (YEI). The main sources are ERDF, EAFRD and ESF, then there are some CF funds EUR 893 million in 015 (smart grids) and 044 (smart cities) and EUR 37.2 million from YEI included in ESF secondary theme O5 'Enhancing the accessibility, use and quality of

[4] The unit responsible for Smart Specialisation.

[5] Unit B5, which serves as a competence centre for regional issues and regional funds within DG CONNECT.

[6] Sörvik, J. and Kleibrink, A. (2015) *Mapping Innovation Priorities and Specialisation Patterns in Europe*, S3 Working Paper Series No 08/2015, European Commission, Joint Research Centre, Institute for Prospective Technological Studies. available online at https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/mapping-innovation-priorities-and-specialisation-patterns-europe

information. The data included from the EAFRD come from Focus Area 6C, 'Enhancing the accessibility, use and quality of ICT in rural areas'. The vast majority of the ICT related investments (98 %) is planned for MO7 'Basic services and village renewal in rural areas', which is the category for broadband investments.

Furthermore, it has been an important EU policy objective to make regions try to use the funds in a more revolving manner. Therefore, it is also of great interest to DG CONNECT to know the financial forms of different investments in the OPs and, in particular, to what extent regions and MSs are using financial instruments.

2.3 Keyword search of Operational Programmes

One of the original ideas for this project was to try to find ways to connect keywords to planned investments in ICT. It originated from an effort by DG CONNECT, which developed a Microsoft Word macro to search OPs for specific keywords.

In an initial effort to test the idea of doing a keyword search, JRC-IPTS staff used a search word list that had been generated by a number of DG CONNECT units and supplemented it with keywords identified in the case studies of the five OPs. The JRC-IPTS ran multiple automated searches in 10 OPs from Greece, Poland and Spain to explore which ICT activities are indicated in OPs beyond those which are encoded in the normal CoIs. This process found evidence that supported the findings in the case studies and the search of the Infoview/SFC2014 data. Most countries plan to invest in ICT both as a horizontal enabler and as a sectoral specialisation, and the encoding of ICT activities goes beyond TO2.

The tests also supported the case study findings that it would not be possible to connect keywords with financial allocations for specific activities, and showed that the frequency of keywords would not give any indication of the size of investment. A keyword search could provide complementary information on the ICT areas that regions and MSs plan to invest in. It could also indicate in which regions a topic is considered relatively more important by identifying the frequency of keywords mentions in different OPs, both internally and in comparison with other regions and MSs. Such a search could give further details on ICT topics, as well as an overview of activity levels on an EU scale.

When exploring the keyword search, both in the case studies and in the first automated searches, groupings of keywords into activity areas emerged. These activity areas reflect both the different themes that DG CONNECT units are covering and also different kinds of ICT issues. This list, together with the tool, was presented at a workshop involving representatives from DG CONNECT. The list was updated at this meeting and through subsequent email correspondence. DG CONNECT units were asked to provide their 10 most important keywords and synonyms to search for in OPs, which should not be too general (as this would lead to all OPs being identified) or too specific (as no OPs would be identified). The reason for limiting the number of keywords to approximately 10 per activity area was to make the list manageable. The keyword list has since been sent for revision to DG CONNECT staff, together with a survey on the functioning of the tool.

The list of activity areas is (see full list of activity areas and keywords in Appendix 2):

- digital single market/digital agenda;
- advanced computing;
- broadband and digital networks;
- components;
- digital content, creative industries and digitisation of culture;
- digital science;
- e-Government;
- e-Health;
- e-Inclusion;
- ICT innovation;
- smart cities and smart grids;

- trust, security and authentication.

The keywords are grouped into a number of activity areas to make them more manageable. The keywords and activity areas are used to operate the tool and to search the database of keywords. However, in addition to the keywords, a broader set of search words was used to search the OPs and to generate the keyword database. For this purpose, a number of synonyms and different kinds of inflections of words were used to generate a hit for each keyword. We also carried out a cross-word search, in which a list of search words related to the keywords was cross-searched to determine whether they appear in the same sentence as different ICT terms.

The activity areas and keywords are all in English and are presented only in English in the tool. However, the search words were translated into the original languages and then used to search the section on actions to be supported in the OPs. All English OPs were searched using English terms whereas the other languages were searched using the search terms both in English and in the original language.

Furthermore, the translation of the keywords was first carried out using a machine translation tool and the translated terms were later verified by staff at JRC-IPTS with specific language skills. However, we suspected that, depending on grammatical complexity, the hit rate for keywords in some languages was lower than it should be. For this reason, the updated and corroborated keyword list was sent for professional translation, which improved the search results substantially, in particular for Eastern European languages.

2.4 Quality review

In order to further verify the use of codes and their relevance to planned ICT investments, it was decided to carry out a number of interviews with penholders (the people in regions and MSs who write the OPs) and DG REGIO desk officers interacting with regions on how to encode the programmes. Respondents were chosen to be representative of regions/MSs that showed the following characteristics:

- a broad range of institutional set-ups;
- planning to use many of the relevant CoIs;
- planning to invest substantially in ICT;
- investing in some of the related CoIs, in particular in 004, 015, 044 (as these are not usually included in the two standard ICT groupings of codes);
- investing in ICT core CoIs in TOs apart from TO2;
- planning to invest in ICT within their TO1 Smart Specialisations.

The biggest planned investors in ICT in the main CoI are the Czech Republic, Spain, France, Hungary, Italy and Poland. Within these countries, Andalucía (ES), Puglia (IT) and Provence Alpes Côte d'Azur (FR) were of particular interest as they plan to invest in relevant CoIs and also plan to invest in ICT under their Smart Specialisation strategy. This was also the case in Poland, which showed a particular coding pattern. This was the only country to code ICT investments under CoI 101. Furthermore, Croatia planned to invest in a broad range of ICT-related codes, which made it interesting, and this was the only country to plan investments in ICT and code it under CoI 121. Two French regions, Île de France and Provence Alpes Côte d'Azur, were also the only regions to include a number of CoIs related to R&I (normally TO1 or TO3) under TO2.

This review led to a list of regions and MSs where representatives have been interviewed:[7]

- Croatia: national level;

[7] For the name of the respondents, see Appendix 3.

- Czech Republic: national level and DG REGIO;
- France: Provence Alpes Côte d'Azur
- Hungary: national level;
- Italy: DG REGIO, and the regions of Emilia-Romagna and Puglia;
- Poland: national level and the region of Lodz;
- Spain: Andalucía.

The answers we got from the respondents indicated that regions and MSs mainly use what we had identified as core CoIs to describe ICT investments, but this happens beyond TO2. ICT investments are challenging to classify as they are an end in themselves, but also very often a means to achieve something else. The responses showed that there will be ICT investments in almost all TOs. To capture ICT investments, it is necessary to look beyond the TOs, as the core CoIs are more relevant. Appendix 4 lists examples of areas related to ICT that regions and MSs plan to invest in under the different CoIs.

The standard description of the CoIs includes two sections with headings indicating ICT and which the respondents generally use for ICT; these are in the core groups of CoIs 045–048 (broadband-related) and CoIs 078–082 (e-Government, ICT uptake, content, SME support, services and applications). Respondents were also of the opinion that it makes sense to include CoI 004 (SME and large company collaboration in ICT), CoI 015 (smart grids), CoI 044 (smart cities) and CoI 05 ESF (for digital skills) in the core CoIs as most respondents view these as ICT-related categories.

Outside these ICT categories there will also be other types of investments in ICT as a direct aim and as enablers, though these are not always classified under TO2.

- All regions will invest in R&I in ICT-related activities under TO1 and TO3 and in a number of CoIs[8] beyond the core CoIs of 004 and 082. ICT-related support to SMEs seems to be more strongly connected to the categories of 082 and 004. However, some regions will also choose other CoIs.[9] However, this is less common, and these CoIs also include other investments that are not ICT related.
- Similarly, there will be investments in e-Government beyond 078 in 092 and 093.
- Support to digital content extends beyond 079, for example to 074, 075, 076, and 077. Puglia here indicates that these investments for culture and tourism are strongly related to ICT and up to 25–30 % can be ICT related.
- There will be investments in smart grids and smart cities in the CoIs of 087 and 088, which go beyond 015 and 044.
- There are quite different approaches to e-Health, with many of the responding regions coding this not only in 081, which is for e-Health, but also in 053, 107, 112, which relate to health infrastructure, healthy and active ageing and enhancing access to care services. Some regions will code e-Health only in 081 but Poland, nationally, codes it under 078, because it sees e-Health as a public service and as part of its wider e-Government programme. Hungary will code it all under 112. At the same time, Hungary estimates that, of all investments under 112, approximately 25 % will be ICT related. Puglia will invest in 053, 081 and 112. As Puglia has a strong focus on ICT, a rough indication is that 60 % of all the health-related investments is connected to ICT in all CoIs. Provence Alpes Côte d'Azur is planning for an incubator with a health component that is partially encoded under 053.
- Various methods are used to code digital skills, mainly the ESF secondary theme 05 and CoI 080 (e-Inclusion), but also the categories 115, 116, 117 and 118 and to some extent categories 050, 051, 051 and 109. For example, in Puglia investment in digital skills will be coded in 051, 052, 109, 115 and 116. There are

[8] Notably 002, 049, 056, 057, 058, 059, 060, 061, 062, 064, 066 and 067.
[9] Notably:001, 056, 062, 063, 064, 066, 067, 072, 073, 074, 075 and 104.

also Polish investments within CoI 101. Poland, both in the national digital programme and in regions, will invest under TO2 in CoI 101, 'Cross-financing for training on the operation and use of communication and information systems related to investments in e-Government and open government'. This concerns projects aimed at building e-Administration.

A further message was that regions and DG REGIO desks are working to secure the quality of the programming so that it is consistent with correct coding practices. For example, in the Czech Republic an expert group suggests in which categories projects should be coded, and also reviews the final programming. The DG REGIO desks also mention that they work actively to correct OPs so that activities are coded in the correct way. This is confirmed by some respondents, who reported that they have changed their coding after DG REGIO suggestions.

However, coding is difficult and may be particularly difficult for ICT, as there is the double dimension of this being both an aim and an enabler. How can a project that has many aims be fitted into a single category? Furthermore, the fit between existing categories and the projects that are being planned is not always perfect. For example, ICT-related activities such as e-Health and e-Government are being encoded in categories that were never intended for ICT activities. Some regions also acknowledge that in order to have flexibility over the programming period add more CoIs than may be needed, likewise some code investments with parts both in Multi-TO and TO2 to have flexibility.

To determine if we could find a way to quantify ICT investment classified in other CoIs, we asked respondents to estimate the amounts going to ICT. Most respondents did not want to give an estimate. However, Hungary indicated that around 20 % of investments in R&I and SME support will go to ICT, based on the investments from previous programming periods. In Puglia up to 60 % of Smart Specialisation or TO1 investments are estimated to be ICT related, as is 25 % of SME support (TO3), as there is a strong ICT focus in the region. Two regions estimated that, based on current plans and future activity, around 1–3 % of all ERDF would go to ICT. As mentioned before, we had also observed in another study of Smart Specialisation priorities that around 10 % were ICT related.

Taking this into account, our suggestion was to include the strict core CoIs and the relevant non-core CoIs, in particular those that are already being coded under TO2 in the tool. We considered adding other categories to the tool and using a standard attribution of around 10–15 % of the amounts. However, this is probably not to be recommended, as these estimates are too vague. However, in Table 1, we use this approach to give a narrow estimate, a best estimate and a broader estimate.

In the tool we have also created a predefined filter, to gather the amounts of investment that we found most strongly connected to ICT; this consists of the core ICT CoIs, the non-core CoIs under TO2 and the EAFRD and ESF ICT investments. This is what can be more securely attributed to ICT, but one should bear in mind that ICT-related investments are higher, in particular for TO1, R&I, and probably also for health-related investments. However, it is not possible to estimate these other numbers in an accurate way, so we will abstain from including this form of estimate in the tool for the time being.

Table 1. Summarising overview of codes used for different ICT activity areas

Activity area	Narrow definition		Best estimate		Broad estimate	
	CoIs under TO2	Funding (million EUR)	Main CoIs under all TO* or non-core under TO2 only**	Funding (million EUR)	Including 10 % of these additional CoIs	Funding (million EUR)
Broadband and ICT infrastructure	045, 046, 047, 048, EAFRD	5 956	045,* 046,* 047,* 048*, EAFRD	6 877	-	6 877
e-Government	078	2 811	078*	3 428	092, 093	3 565
Digital content	079	745	079*	971	074, 075, 076, 077	1 140
e-Inclusion and digital skills	080, 101, 096, 121	1 134	080,* 05* (ESF), 096,** 101,** 121**	3 853	050, 051, 052, 109, 115, 116, 117 and 118	8 457
e-Health and active ageing	081	772	081*	1 006	053, 107, 112	1 885
ICT SME support and e-Commerce	004, 056, 062, 063, 064, 065, 066, 071, 082	802	004,* 082,* 056,** 062,** 063,** 064,** 065,** 066,** 071**	2 112	001, 056, 062, 063, 064, 066, 067, 071, 072, 073, 074, 075, 104	7 424
Smart grids and smart cities	015, 044	0	015,* 044*	3 138	087, 088	3 882
Advanced computing, components, digital science	049, 059, 061	4	049,** 059,** 061**	4	002, 049, 057, 058, 059, 060, 061	2 070
Total		**12 225**		**21 389**		**35 300**

3. The ICT Monitoring tool

The outcome of this process is the ICT Monitoring tool that allows the user to search ESIF data (ERDF, CF, ESF, YEI and EAFRD) by MS ('country'), region, CoI, TO, activity area (keywords) and financial form and to view the search results in the form of a map or as a list of data.[10]

The development of the tool is based on the background studies described in Chapter 2 and also through continuous interaction with users from DG CONNECT, beginning with a simpler tool that has evolved over time to a full-scale one.

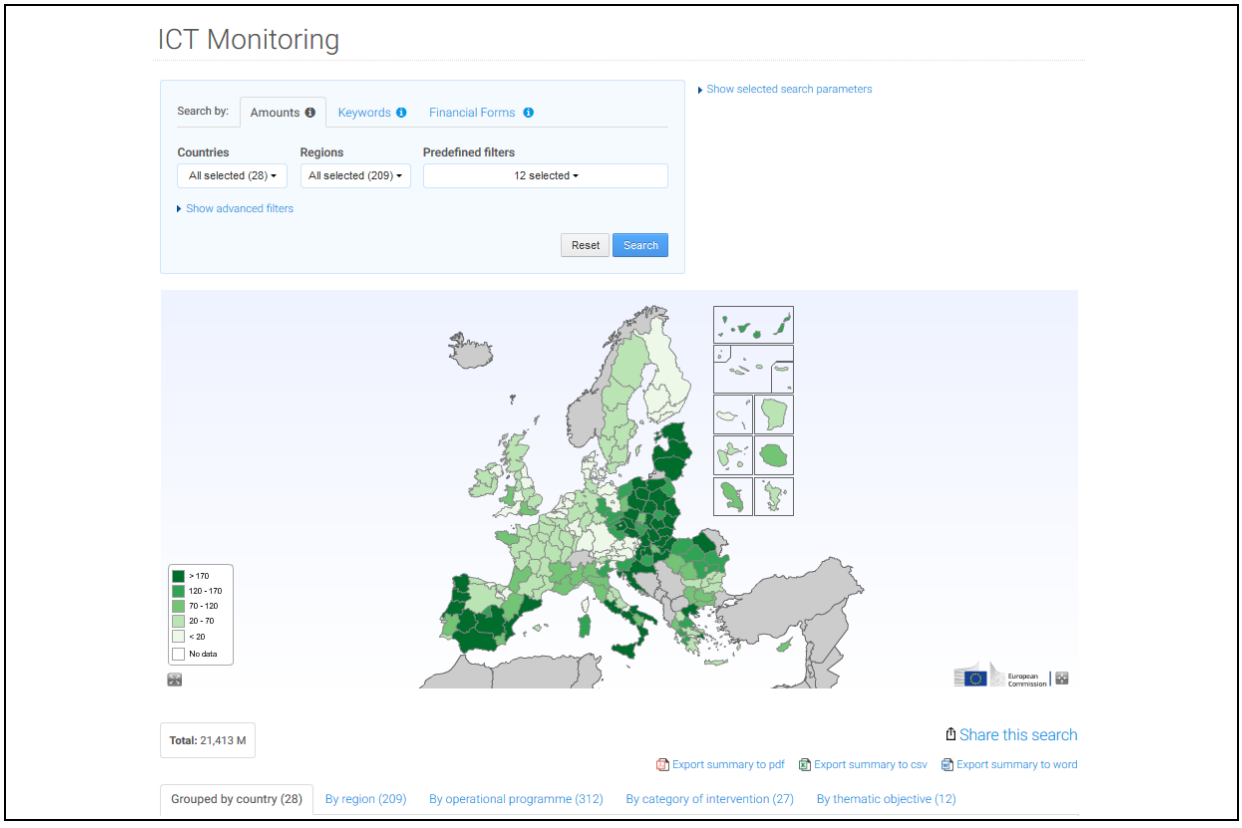
Users can carry out three main types of searches:

- searches for amounts: to identify planned investments through ESIF, based on TOs and CoIs;
- keywords searches: to determine the frequency of keywords in OPs' actions to be supported;
- searches for financial forms: to identify amounts of planned investments through financial instruments.

In each dimension, the users can make simple searches selecting 'country', 'region', or one or more of the predefined filters. There is also the option for users to create more advanced, tailor-made, searches. The predefined filters for each search form are described below.

The search result is presented on a map and in tables. The parameters of each search are depicted on the right-hand side of the tool.

Figure 1. ICT monitoring tool front page.



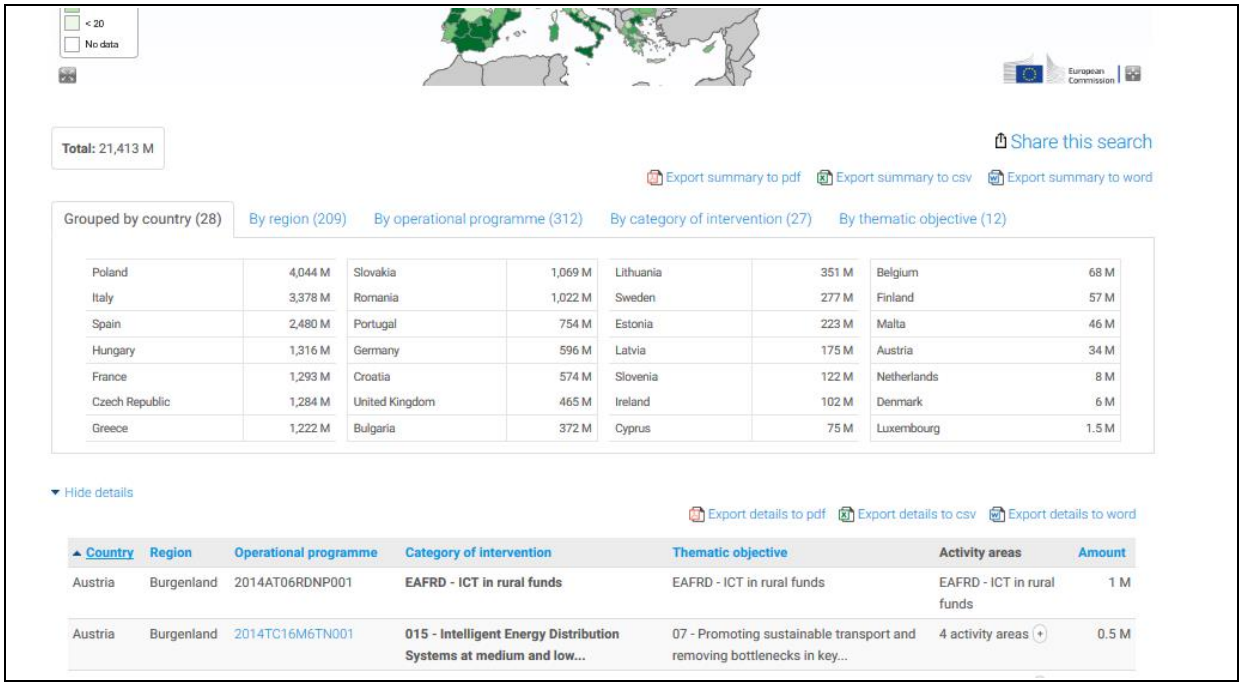
[10] The tool can be accessed through this link: http://s3platform.jrc.ec.europa.eu/ict-monitoring

Below the map a summary table presents ranked results depending on the chosen dimension. The data are grouped according to country, region, OP, TO and CoI, or activity area and keywords. Another table shows all single data posts but not grouped.

The OPs are presented with active links (only ERDF and ESF OPs and not the EAFRD ones). The active links take the user to a dedicated webpage on the Inforegio site or the ESF site, where more information on the OP can be found, in most cases accompanied by links to the entire OP text.

The search results can be shared with other users by clicking the 'share' button, which generates an email with a web link to the current search result. The user can also export the search result as a Microsoft Excel, Microsoft Word or PDF file.

Figure 2. ESIF ICT tool search results.



The predefined filters differ for each of the three dimensions described above. Users can also select advanced filters in each dimension to carry out a more refined search.

Amounts

When searching in amounts, the user can select countries, regions and one or many of the predefined filters in the simple search. The predefined filters for amounts include the following CoIs:

- all ICT-related CoIs (displays data from TO2 and CoI 004, 015, 044–048, 078–082 in the other TOs, as well as 05 from ESF and EAFRD);
- ERDF broadband and digital networks (CoIs 045–048);
- ERDF government (CoI 078);
- ERDF digital content (CoI 079);
- ERDF e-Inclusion (CoI 080);
- ERDF e-Health and active and healthy ageing (CoI 081);
- ERDF ICT SME support and e-Commerce (CoIs 004 and 082);
- ERDF smart grids (CoI 015);
- ERDF smart cities (CoI 044);
- ERDF non-core CoIs in TO2 (including CoIs which are in TO2, but not one of the core CoIs: 049, 056, 059, 061, 062, 063, 064, 065, 066, 071, 096, 101, 121);
- EAFRD ICT in rural funds (displays planned investments in ICT under the EAFRD FA 6C);
- ESF digital skills (ESF secondary theme 05);

- ERDF R&I innovation processes in SMEs/vouchers (CoI 064);
- ERDF skills and lifelong learning (CoIs 115–118).

In the advanced search under 'amounts', the user can choose which TOs and CoIs to include in the search. All TOs and core and non-core CoIs for ICT are included in the data set. CoIs included in the data set are described below.

Keywords

When searching in keywords, the user can select in the simple search countries, regions and one or many of the predefined filters. The predefined filters consist of activity areas, which are groupings of keywords in common themes. The activity areas are:

- digital single market/digital agenda;
- advanced computing;
- broadband and digital networks;
- components;
- digital content, creative industries and digitisation of culture;
- digital science;
- e-Government;
- e-Health;
- e-Inclusion;
- ICT innovation;
- smart cities and smart grids;
- trust, security and authentication.

In the advanced search under keywords, the user can choose to select one or many keywords from a list and whether to do an additive search, using these words, or a cross-search, looking for the combination of keywords, by choosing 'all selected keywords' in the section 'OPs should match'.

The user can also choose to use the free text field, where any keyword can be specified and the tool will suggest which keyword the user might be looking for based on the search words that have been used to build up the keyword database.

The keywords and activity areas indicate which countries and regions aim to invest in different themes, as a result of these keywords being mentioned in OPs that cover the territory. However, there is no connection to any amount of investment, TOs or CoIs.

For the entire list of activity areas and keywords, see Appendix 2.

Financial forms

When using the financial forms search, the user can search countries, regions and predefined filters in the simple form. The predefined filters include:

- all forms of finance in ICT (categories of forms of finance 01, 02, 03, 04, 05, 06 and 07 in TO2);
- financial instruments in ICT (categories of forms of finance 03, 04, 05 and 06 in TO2);
- grants and prizes (categories of forms of finance 01, 02 and 07 in TO2).

The financial forms data are applicable only to ERDF, ESF, YEI and CF OPs; EAFRD is not included. In the advanced search for financial forms, the user can create a specific search based on countries, regions, TOs and different forms of finance, which include:

- 01: non-repayable grant;
- 02: repayable grant;
- 03: support through financial instruments: venture and equity capital or equivalent;
- 04: support through financial instruments: loan or equivalent;
- 05: support through financial instruments: guarantee or equivalent;

- 06; support through financial instruments: interest rate subsidy, guarantee fee subsidy, technical support or equivalent;
- 07; prize.

All the data in the tool have been regionalised. The amounts in the national OPs and interregional OPs have been divided for the regions that are covered by the programmes. In the case of transnational collaboration programmes, amounts have been broken down according to the population size of participating regions; amounts pertaining to non-EU regions are not included. The following programmes have not been included: 2014TC16RFIR002, 2014TC16RFTN010, 2014TC16RFTN008, 2014TC16RFTN009 and 2014TC16RFCB043.

In the case of keywords, the presence of a keyword in a multi-regional programme assigns this keyword to each region covered by the programme. For example, if a national programme mentions e-Health five times, each region will have an indication of the keyword mentioned five times. However, these numbers are not aggregated for MS accounting.

For most MSs, the geographical level used is NUTS2, with the exception of Belgium, Germany, the Netherlands and the UK, where it is NUTS1, and Croatia, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta and Slovenia, where it is the national level.

The data in the tool are estimates, it is planned investments that depend on many factors to be realised. National and interregional OP amounts have been distributed on a per capita basis, which may not be the actual outcome. To avoid presenting estimated data as exact, all the amounts of planned investments in individual posts have been rounded up in the following way:

- EUR 0–0.49 million rounded to EUR 0.5 million;
- EUR 0.5–0.99 million rounded to EUR 1 million;
- EUR 1–1.49 million rounded to EUR 1.5 million;
- EUR 1.5–2.49 million rounded to EUR 2 million;
- EUR 2.5–3.49 million rounded to EUR 3 million;
- EUR 3.5–4.49 million rounded to EUR 4 million;
- and so on.

Some examples of analyses that can be made with the tool are explained and illustrated in the next chapter.

4. Analysing ICT investments in ESIF

In this chapter we describe an analysis of the major ICT investment areas as revealed by the tool. We use the tool to analyse what ICT investments look like on an overarching level, and compare the tool's two major data sources of planned amounts in ESIF and keywords for each of these thematic areas. Finally, we describe a special analysis of financial instruments.

The data described above for both planned amounts and keywords are estimates rather than exact amounts. Estimates are particularly uncertain at the regional level. As described in Chapter 3, the amounts planned in national, multi-regional and transborder collaboration programmes are divided by region, based on their population size and level of development, as indicated in the programmes.

The analysis in this report is based on data extracted from the Infoview database on 5 February 2016. At that point not all OPs had been approved; however, it is likely that the final numbers will be similar to those in this report.

The keywords are also based on estimates, and the presence of a keyword in a multi-regional programme assigns this keyword to each region covered by the programme. For example, if a national programme mentions e-Health five times, each region will have an indication of the keyword mentioned five times. However, these numbers are not aggregated for MS accounting. Furthermore, the translation of the keywords can depend on grammatical complexity, which can result in different hit rates depending on the language used.

4.1 All ICT-related categories of intervention

The tool includes a filter that captures all the main data posts related to planned ICT investments in the ESIF. It consists of the core CoIs in all TOs and the non-core CoIs under TO2, and includes the EAFRD planned investments for ICT. At the time of writing, the planned amount of investment is approximately EUR 21.4 billion. This is almost twice as much as is currently encoded under TO2 (EUR 11.3 billion). The share going into ICT rises from 3.8 % to around 6.6 % of the combined total from ERDF, ESF, CF and EAFRD.

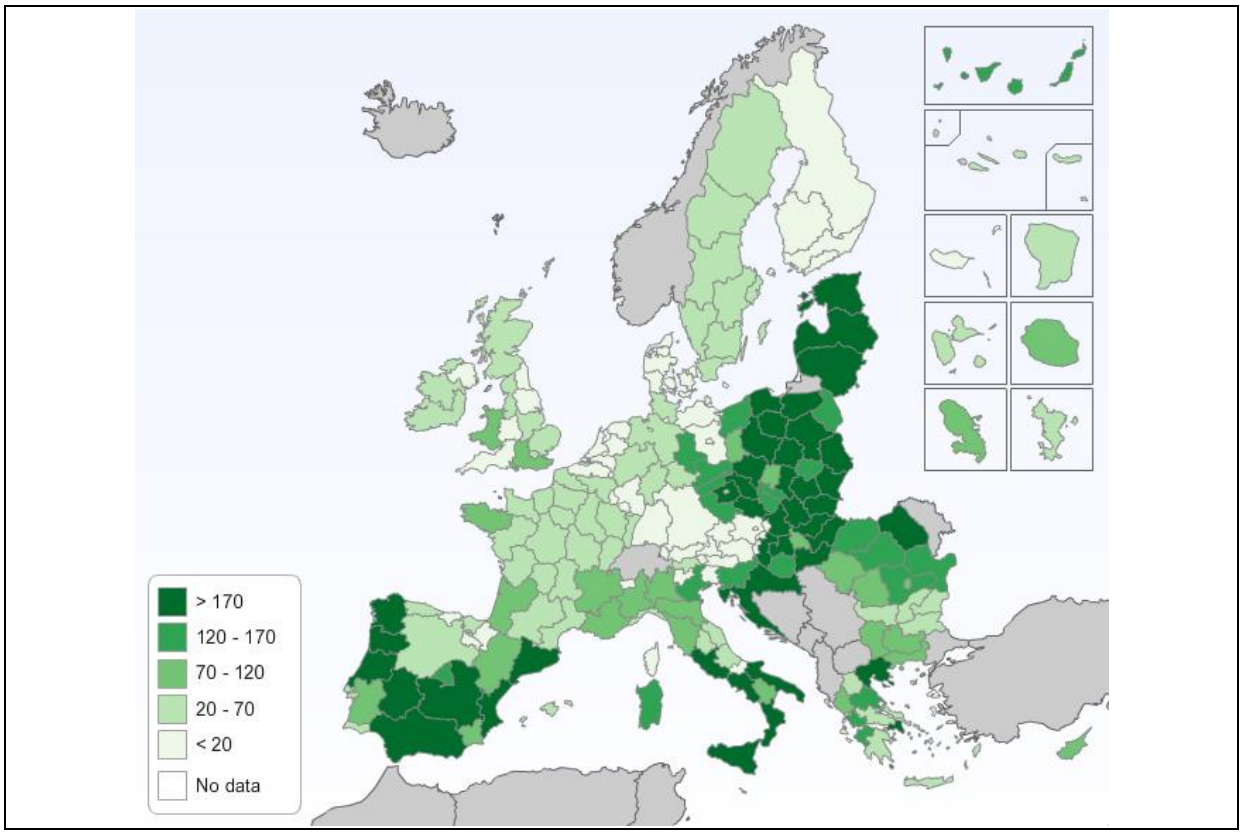
The MSs that plan by far the largest investments in ICT in absolute terms under this measure are by Poland, Italy and Spain, with substantial investments seen in Hungary, France, the Czech Republic, Greece, Slovakia and Romania (see Table 2).

The regions with the largest planned investments are Campania (IT), Sicilia (IT), Andalucía (ES), Slaskie (PL), Puglia (IT), Malopolskie (PL) and Západné Slovensko (SK). The region of Campania, for example, will invest more in ICT than Germany.

When looking at the planned investments under the core CoIs, it becomes apparent that the most important categories are as follows: e-Government services and applications (078); high-speed broadband (≥ 30 Mbps) (046); ESF second theme digital skills (05); intelligent transport systems (044); ICT services and applications for SMEs (082); very high-speed broadband (≥ 100 Mbps) (047); e-Inclusion, e-Accessibility, e-Learning and e-Education (080); intelligent energy distribution systems (015); and healthy active ageing and e-Health (081). If grouping the categories, then broadband and ICT infrastructures attract the most investment.

When looking at the TOs, the most important one is obviously TO2, as it is dedicated to ICT, though the multi-TO also is very important, followed by low-carbon economy, skills and lifelong learning, sustainable transport and investments under EAFRD. There is substantially less investment in TO1 and TO3.

Figure 3. All ICT-related categories of intervention.



Source: ESIF tool and Infoview/SFC2014.

When exploring the activity areas (groupings of keywords) and keywords are examined, a somewhat contrasting image appears. In the actions to be supported under ESIF, the most frequently mentioned keywords relate to ICT innovation: e-Inclusion; broadband and digital networks; digital content; e-Government; and components. For single keywords, the most common examples are related to the following: digital products, services and applications; R&I; start-ups and venture capital; e-Infrastructure and information systems; digital skills and literacy; training and education; and innovation clusters, hubs and incubators. This indicates that it is possible that more ICT activities will take place under TO1 and TO3 than is being revealed by TO and CoI encoding.

Table 2. Overview of major investor countries and regions, most important CoIs and TOs, most frequently mentioned areas of activity and keywords

Country - amount (million EUR)		**Region/MS – amount (million EUR)**		**CoI - amount (million EUR)**		**TO – amount (million EUR)**		**Activity area – frequency of keywords mentioned**		**Keyword– frequency of keywords mentioned**	
Poland	4 044	Campania (IT)	734	078: e-Government services and applications	3 427	02: Enhancing ICT	11 401	ICT innovation	5 033 (6 817*)	Digital products, services and applications	2 020
Italy	3 378	Sicilia (IT)	717	046: ICT: high-speed broadband (≥ 30 Mbps)	3 321	Multi-TO	3 288	e-Inclusion	2 172	Research and innovation	1 700
Spain	2 480	Andalucía (ES)	712	05: ESF second theme ICT	2 297	04: Low-carbon economy	1 642	Broadband and digital networks	1 637	Start-ups and venture capital	1 241
Hungary	1 316	Hrvatska (HR)	574	044: Intelligent transport systems	2 042	10: Skills and lifelong learning:	1 155	Digital content, creative industries and digitisation of culture	1 287	e-Infrastructure and information systems	1 063
France	1 293	Slaskie (PL)	482	082: ICT services and applications for SMEs	1 740	EAFRD–ICT in rural funds	922	e-Government	802	Digital skills and literacy	749

Czech Republic	1 284	Puglia (IT)	461	047: ICT very high-speed broadband (≥ 100 Mbps):	1 500	07: sustainable transport	856	Components	764	Training and education	695
Greece	1 222	Malopolskie (PL)	452	080: e-Inclusion, e-Accessibility, e-Learning and e-Education	1 248	11: Institutional capacity of public authorities	621	Advanced computing	737	Innovation clusters, hubs and incubators	636
Slovakia	1 069	Západné Slovensko (SK)	406	015: Intelligent energy distribution systems	1 080	03: SMEs	565	e-Health	721	Broadband	498
Romania	1 022	Mazowieckie (PL)	367	081: ICT solutions healthy active ageing and e-Health	1 00	09: Social inclusion	386	Smart cities and smart grids	616	e-Culture and digital culture	339
Portugal	754	Východné Slovensko (SK)	356	079: Access to public sector information	970	08: Employment and labour mobility:	346	Digital science	479	Vouchers	315
Germany	596	Lietuva (LT)	351	EAFRD: ICT in rural funds	922	01: Research and innovation	166	Trust, security and authentication	456	e-Government	313
Croatia	574	Norte (PT)	333	048: ICT, Other types of ICT infrastructure/large-scale computer resources/equipment	915	06: Preserving and protecting the environment	64	Digital single market/ digital agenda	433	e-Health	311

*The activity area 'ICT innovation' includes a number of categories that are searched in a specific ICT context and some that are not delimited to ICT. . The first indicated value does not include the broader definitions. The value in brackets includes all categories. These keyword categories are as follows: start-ups and venture capital, SME support, service innovation, social innovation, vouchers, ICT start-ups and venture capital, service innovation in ICT, social innovation in ICT and ICT vouchers.

4.2 Broadband

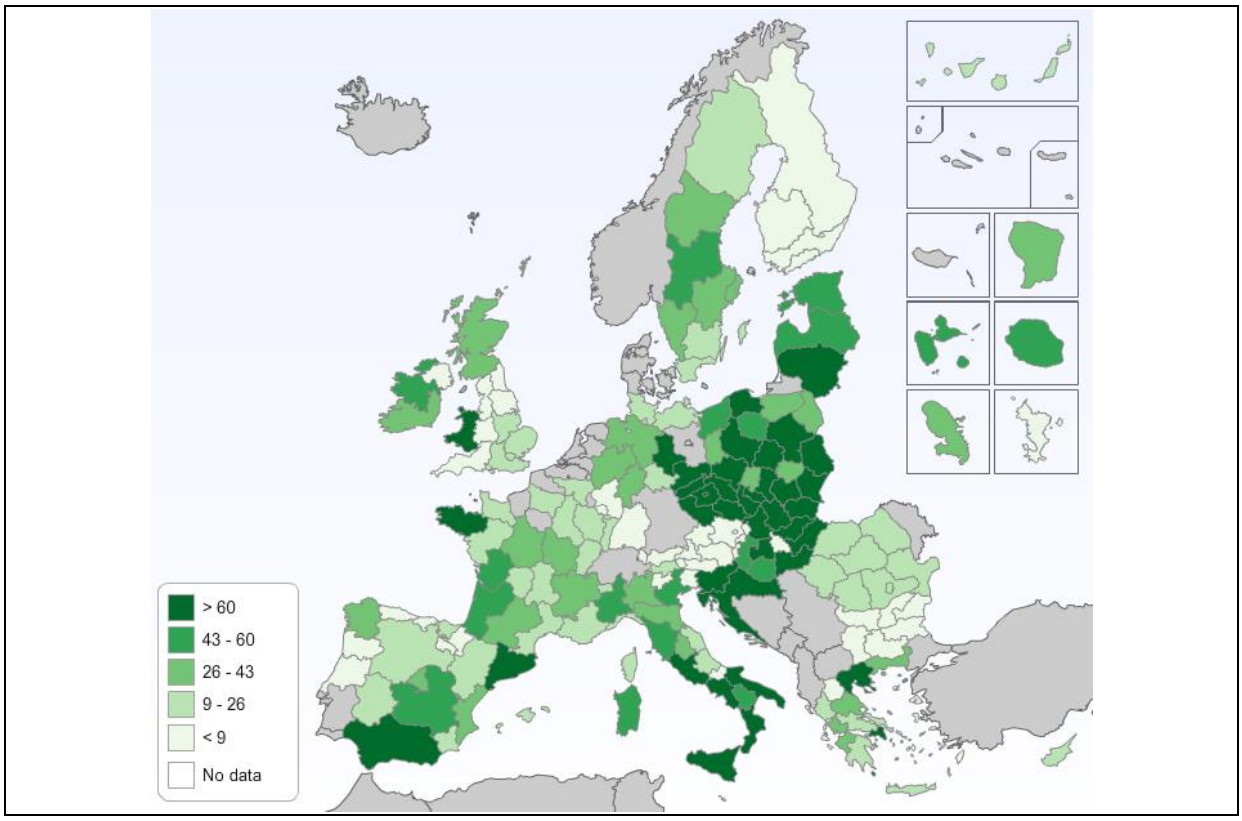
Planned investments in broadband amount to approximately EUR 6.9 billion. In this case we are looking at CoIs 045–048 and the EAFRD which, according to DG AGRI staff, will almost entirely go to broadband investments (98.5 %).

The largest investors are Italy (EUR 1 444 million), Poland (EUR 1 025 million), France (EUR 680 million), the Czech Republic (EUR 563 million) and Spain (EUR 467 million). The largest regional investors are Hrvatska (HR) (EUR 335 million), Sicilia (IT) (EUR 300 million), Campania (IT) (EUR 294 million), Calabria (IT) (EUR 153 million), Slaskie (PL), (EUR 132 million) and Puglia (IT) (EUR 126 million).

The most important TOs are TO2 (EUR 5.1 billion), EAFRD (EUR 922 million) and multi-TO (EUR 567 million). The largest CoIs are broadband network (access/local loop; ≥ 30 Mbps; 046) with EUR 3.3 billion, followed by very high-speed broadband network (access/local loop; ≥ 100 Mbps; 047), at EUR 1.5 billion, then other types of ICT infrastructure/large-scale computer resources/equipment (including e-Infrastructure, data centres and sensors, even when embedded in other infrastructure such as research facilities, environmental and social infrastructure; 048) with EUR 915 million, EAFRD with EUR 869 million and backbone/backhaul network (045) with EUR 314 million.

The results for countries using broadband keywords in their OPs were similar to the results for financial amounts, with the addition of Ireland and the UK; Poland was an exception, mentioning broadband relatively rarely. The regions are also similar, with Sicilia (IT) mentioning broadband keywords most frequently. The most common keywords connected to broadband relate to e-Infrastructure and information systems, (mentioned 1 063 times), broadband (mentioned 498 times), data centres and storage, (mentioned 34 times), wireless (mentioned 25 times), GÉANT and networks for research, (13 times) and broadband and engineering projects (mentioned four times).

Figure 4. Broadband.



Source: ICT Monitoring tool and Infoview/SFC2014.

4.3 e-Government

The main category for e-Government is CoI 078, 'e-Government services and applications' (including e-Procurement, ICT measures supporting the reform of public administration, cyber-security, trust and privacy measures, e-Justice and e-Democracy). MSs are planning to invest EUR 3 427 million in this CoI, and almost everything is coded under TO2 (EUR 2.8 billion) and multi-TOs (EUR 509 million).

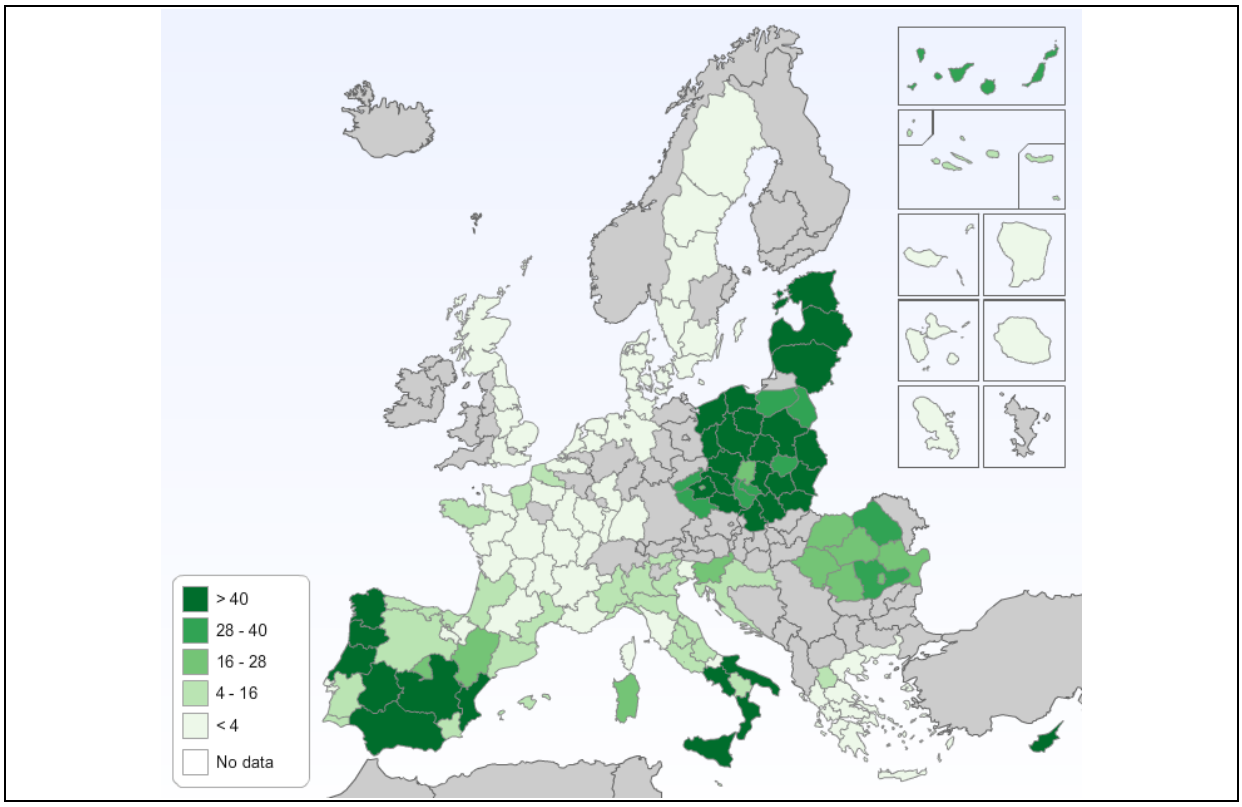
The largest investor countries are Poland (EUR 1 054 million), Spain (EUR 544 million), Italy (EUR 402 million), Slovakia (EUR 352 million) and the Czech Republic (EUR 317 million). The more important regions are Malopolskie (PL) (EUR 135 million), Západné Slovensko (SK) (EUR 135 million), Andalucía (ES) (EUR 133 million), Východné Slovensko (SK) (EUR 118 million) and Slaskie (PL) (EUR 115 million).

For keywords, the countries mentioning e-Government most frequently are Italy (330 times), Spain (135 times), Portugal (65 times), France (60 times) and Romania (40 times) The top 15 regions in terms of numbers of mentions of e-Government are all in Italy; the top five are Veneto (97 times), Calabria (96 times), Puglia (92 times), Sardegna (92 times) and Sicilia (90 times). This phenomenon can probably be attributed to common e-Government activities in a national or multi-regional programme, as a result of which it is mentioned frequently. The most important keywords are e-Government, (mentioned 313 times), open and big data (mentioned 128 times), interoperability of public data (mentioned 122 times), e-Invoicing (mentioned 72 times) and online payment (mentioned 55 times).

There is also a predefined filter for trust activities, which also relates to the e-Government CoIs. As for e-Government, Italy is the MS with the most regions mentioning trust-related keywords. The countries most frequently mentioning trust-related keywords are Italy (177 times), Spain (76 times), Portugal (52 times), France

(50 times) and Croatia (17 times). On a regional level, those most frequently mentioning trust-related keywords are again five Italian regions: Sardegna (50 times), Calabria (49 times), Puglia (48 times), Sicilia (46 times) and Basilicata (44 times). The more important trust-related keywords are security and data protection (mentioned 202 times), interoperability, interconnection (mentioned 142 times), electronic identification (mentioned 31 times), privacy mentioned 27 times) and secure infrastructure (mentioned six times).

Figure 5. e-Government.



Source: ICT Monitoring tool and Infoview/SFC2014.

4.4 Digital content

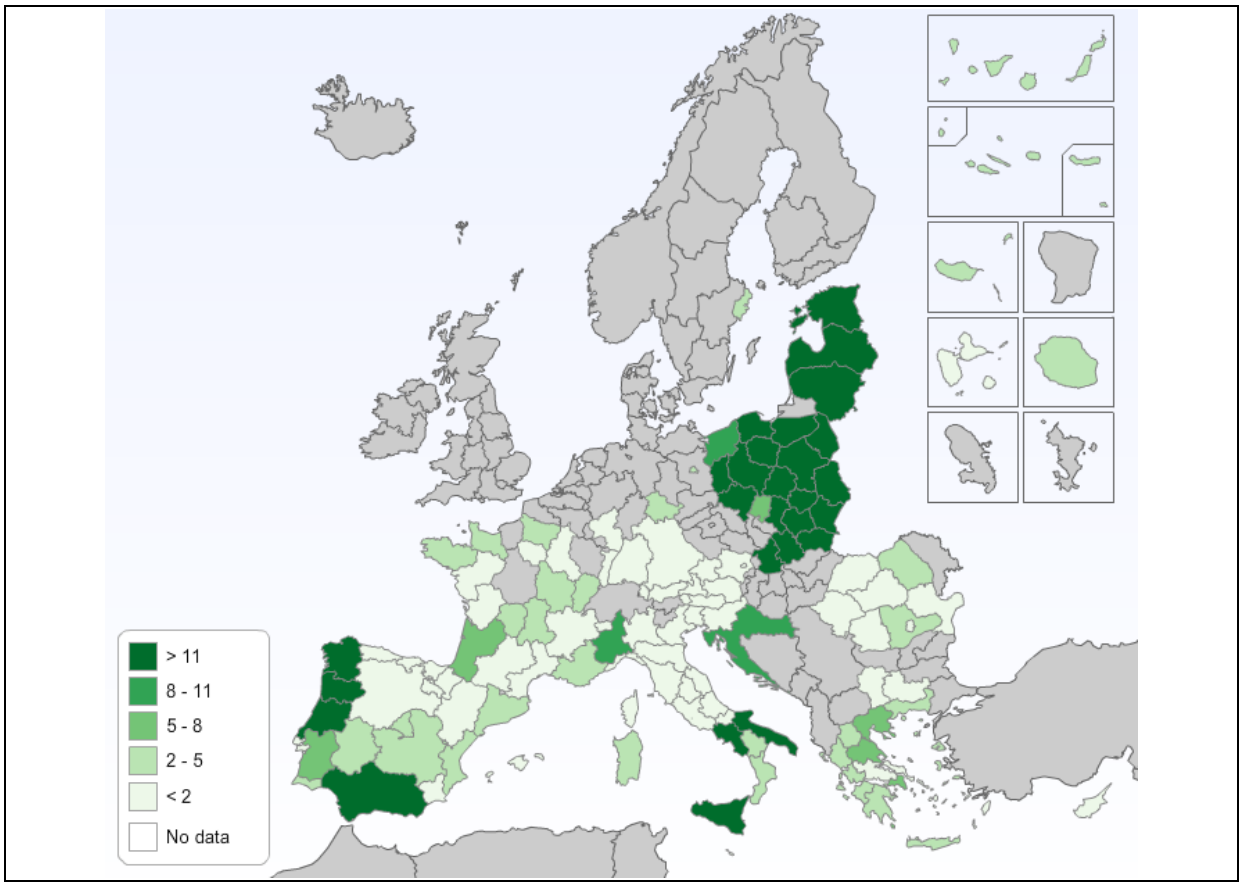
The main CoI for digital content is 079, 'Access to public sector information' (including open data e-Culture, digital libraries, e-Content and e-Tourism). Under this category EUR 970 million of investment is planned, which is mainly coded under TO (EUR 746 million), multi-TO (EUR 167 million) and TO6 (EUR 38 million).

The main investing countries are Poland (EUR 403 million), Italy (EUR 114 million), Spain (EUR 79 million), Portugal (EUR 73 million) and Latvia (EUR 55 million). The regions with largest planned investments are Lubelskie (PL) (EUR 64 million), Latvija (LV) (EUR 55 million), Andalucía (ES) (EUR 48 million), Lietuva (LT) (EUR 45 million) and Warminsko-Mazurskie (PL) (EUR 44 million). Compared with the other categories, here the Baltic States are more prominent, but they are not the MSs most frequently mentioning digital content in their keywords. This, once again, is Italy.

The countries most frequently mentioning keywords related to digital content are Italy (552 times), France (195 times), Spain (149 times), Poland (112 times) and Greece (95 times). The regions mentioning digital content keywords most frequently are once more all Italian: Sicilia (122 times), Puglia (121 times), Veneto (111 times), Calabria (103 times) and Lombardia (102 times). The most common keywords are e-Culture and digital culture (mentioned 339 times), digitisation (mentioned 187 times), creativity and

design (mentioned 173 times), ICT and tourism (mentioned 137 times), and digital content and media (mentioned 121 times).

Figure 6. Digital content.



Source: ICT Monitoring tool and Infoview/SFC2014.

4.5 e-Inclusion and digital skills

With regard to e-Inclusion and digital skills, the tool provides data on planned investments through three main groups of data: (1) CoI 080 on e-Inclusion, e-Accessibility, e-Learning and e-Education services and applications, digital literacy; (2) ESF Second Theme 'Enhancing the accessibility, use and quality of ICT' (05); and then the user can also search the four CoI 115-118; only the two first ones are included in the main ICT related CoI. (1) and (2) together amount to EUR 3.5 billion, with EUR 2.3 billion for the latter and EUR 1.2 billion for the former. The first two categories are most commonly coded in TO10 (ESF), and then TO2 (080), but also substantially in TO11, multi-TO, TO9 and TO8.

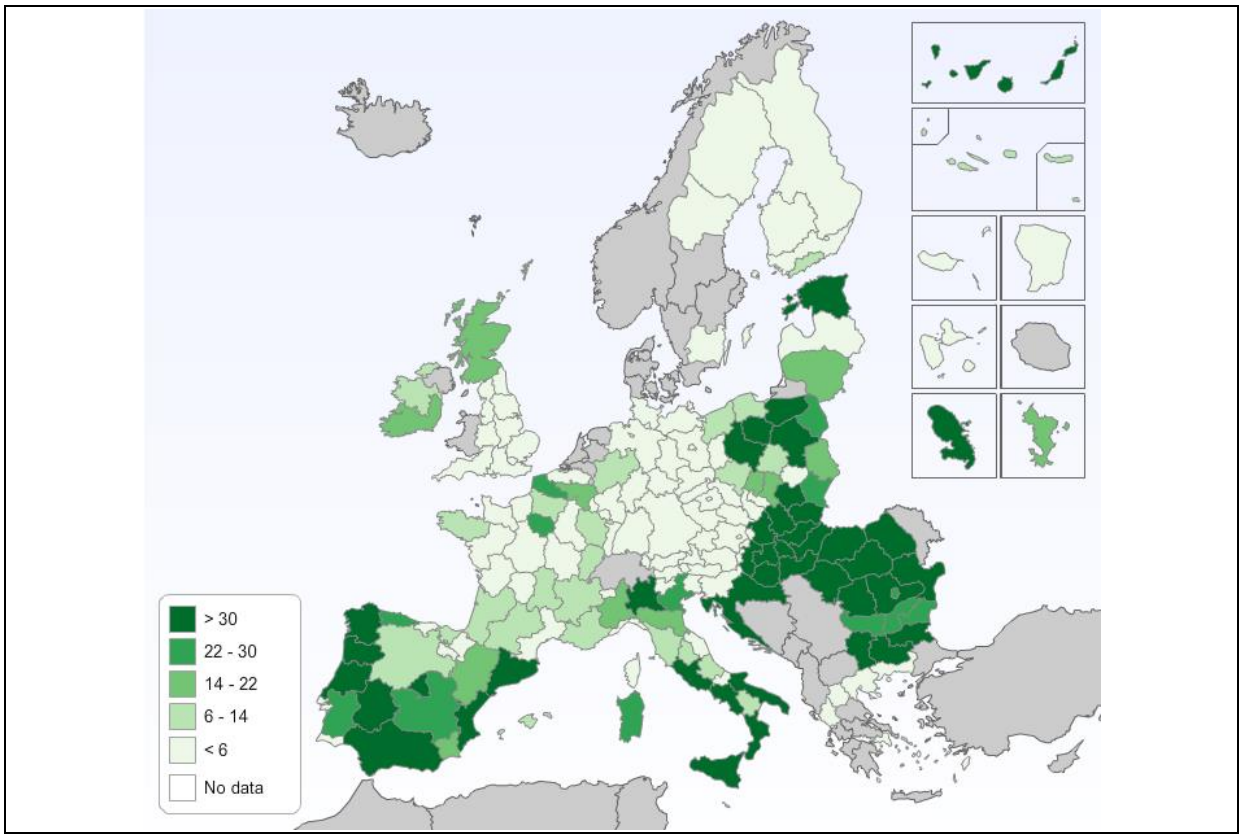
The main countries planning investments in e-Inclusion and digital skills are Spain (EUR 635 million), Italy (EUR 475 million), Poland (EUR 469 million), Romania (EUR 360 million) and Hungary (EUR 311 million). The main regions are Andalucía (ES) (EUR 189 million), Hrvatska (HR) (EUR 124 million), Norte (PT) (EUR 120 million), Malopolskie (PL) (EUR 100 million) and Ciudad Autónoma De Ceuta (ES) (EUR 86 million).

In addition to the main CoI of ESF 05 and 080, the skills-related categories of 115–118 are also important. However, we do not know at this point to what extent digital skills beyond the ESF secondary theme are included in these data. For CoIs 115–118, there are total planned investments of EUR 27.3 billion, with EUR 23.2 billion under TO10 and EUR 4 billion in multi-TO and minor posts in T01, TO8, TO11, TO6 and TO9. The main countries are Poland (EUR 4 086 million), Portugal (EUR 3 846 million), Italy (EUR 3 099

million), Germany (EUR 2 527 million) and the UK (EUR 2 002 million). The main regions are Norte (PT) (EUR 1 918 million), Centro (PT) (EUR 1 230 million), Andalucía (ES) (EUR 693 million), Wales (UK) (EUR 540 million) and Puglia (IT) (EUR 539 million).

For keywords, the countries most frequently mentioning e-Inclusion are Italy (902 times), Spain (348 times), France (231 times), Poland (167 times) and Croatia (144 times). The regions most frequently mentioning e-Inclusion are five Italian ones: Puglia (258 times), Veneto (245 times), Sicilia (230 times), Calabria (228 times) and Sardegna (226 times). The most commonly used keywords are digital skills and literacy (mentioned 749 times), training and education (mentioned 695 times), eLearning (mentioned 221 times), jobs (mentioned 205 times) and digital inclusion (mentioned 140 times).

Figure 7. e-Inclusion.



Source: ICT Monitoring tool and Infoview/SFC2014.

4.6 e-Health and active ageing

e-Health and Active and healthy ageing should primarily be coded in CoI 081, ICT solutions addressing the healthy active ageing challenge and e-Health services and applications (including e-Care and ambient assisted living). This CoI includes slightly more than EUR 1 billion of planned investments, mainly coded under TO2 (EUR 772 million) and multi-TO (EUR 173 million).

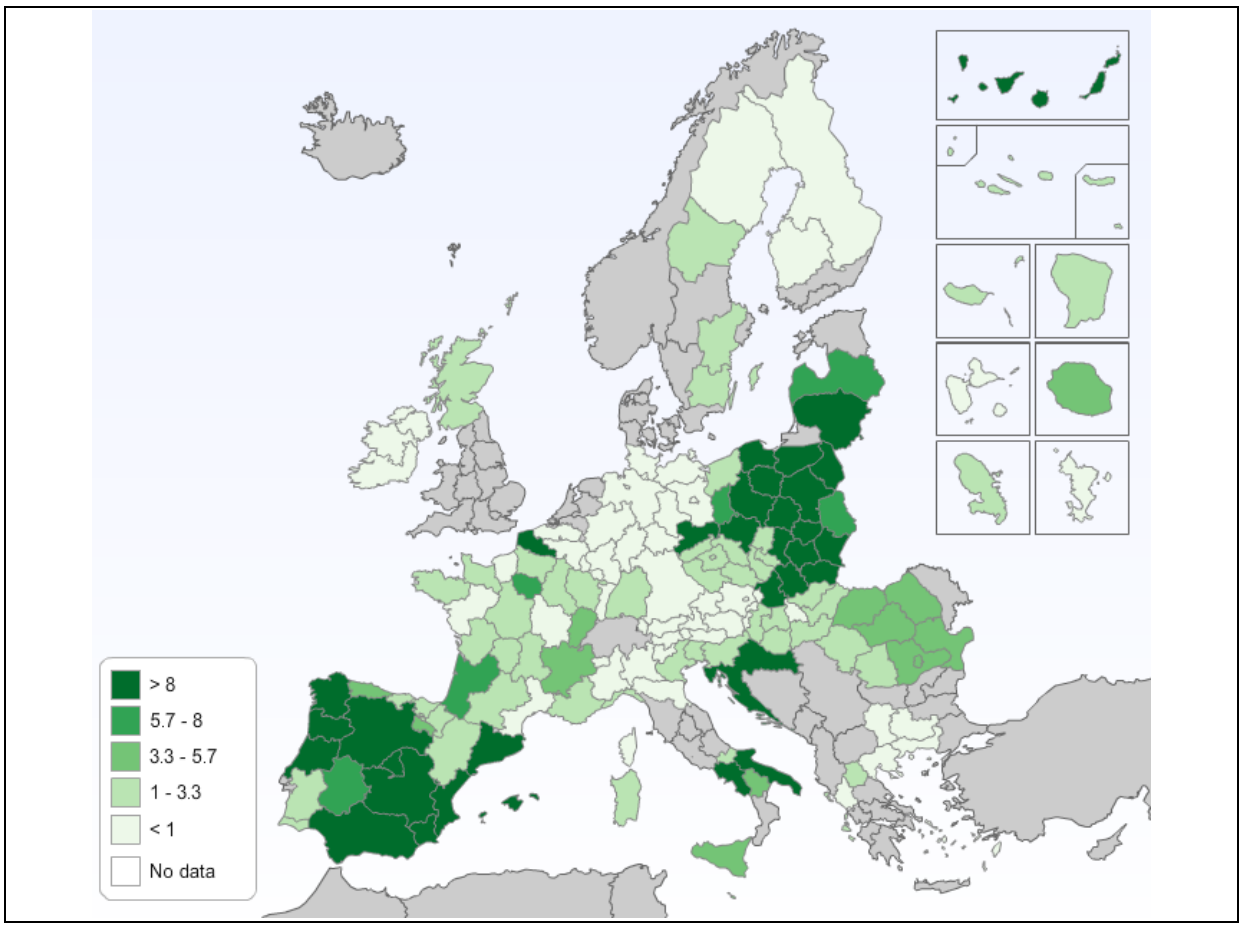
The main countries planning investments in this area are Poland (EUR 351 million), Spain (EUR 257 million), Slovakia (EUR 70 million), France (EUR 65 million) and Italy (EUR 76 million). Among the regions, Spanish and Polish regions predominate: Mazowieckie (PL) (EUR 69 million), Andalucía (ES) (EUR 57 million), Comunidad Valenciana (ES) (EUR 52 million), Slaskie (PL) (EUR 45 million) and Malopolskie (PL) (EUR 41 million).

Under CoI 107 (active and healthy ageing), which may contain additional e-Health investments, EUR 561 million of investment is planned. However, none of this is coded as TO2, being mainly coded as TO8 and multi-TO. In this CoI, Poland is once again the largest investor (EUR 336 million) and France is among the largest (EUR 37 million), but a number of MSs that have not previously appeared as the largest investors emerge: the Netherlands (EUR 101 million), Slovenia (EUR 35 million) and Austria (EUR 24 million). The regions are dominated by those from Poland: Slaskie (PL) (EUR 55 million), West-Nederland (NL) (EUR 48 million), Wielkopolskie (PL) (EUR 37 million) and Dolnoslaskie (PL) (EUR 33 million).

For keywords, the countries most frequently mentioning e-Health and active ageing are France (131 times), Italy (123 times), Spain (122 times), Poland (71 times) and Portugal (41 times). The main regions are Hrvatska (HR) (39 times), Malta (MT) (34 times), Comunidad De Madrid (ES) (32 times), Andalucía (ES) (30 times) and Islas Baleares (ES) (30 times).

The most commonly used keywords are e-Health (311 times), telemedicine and telemonitoring (85 times), integrated care (62 times), independent living (56 times) and active and healthy ageing (54 times).

Figure 8. e-Health, and healthy and active ageing.



Source: ICT Monitoring tool and Infoview/SFC2014.

4.7 ICT SME support and e-Commerce

For ICT SME support, we use two CoIs: 082, 'ICT services and applications for SMEs' (including e-Commerce, e-Business and networked business processes), living labs, web

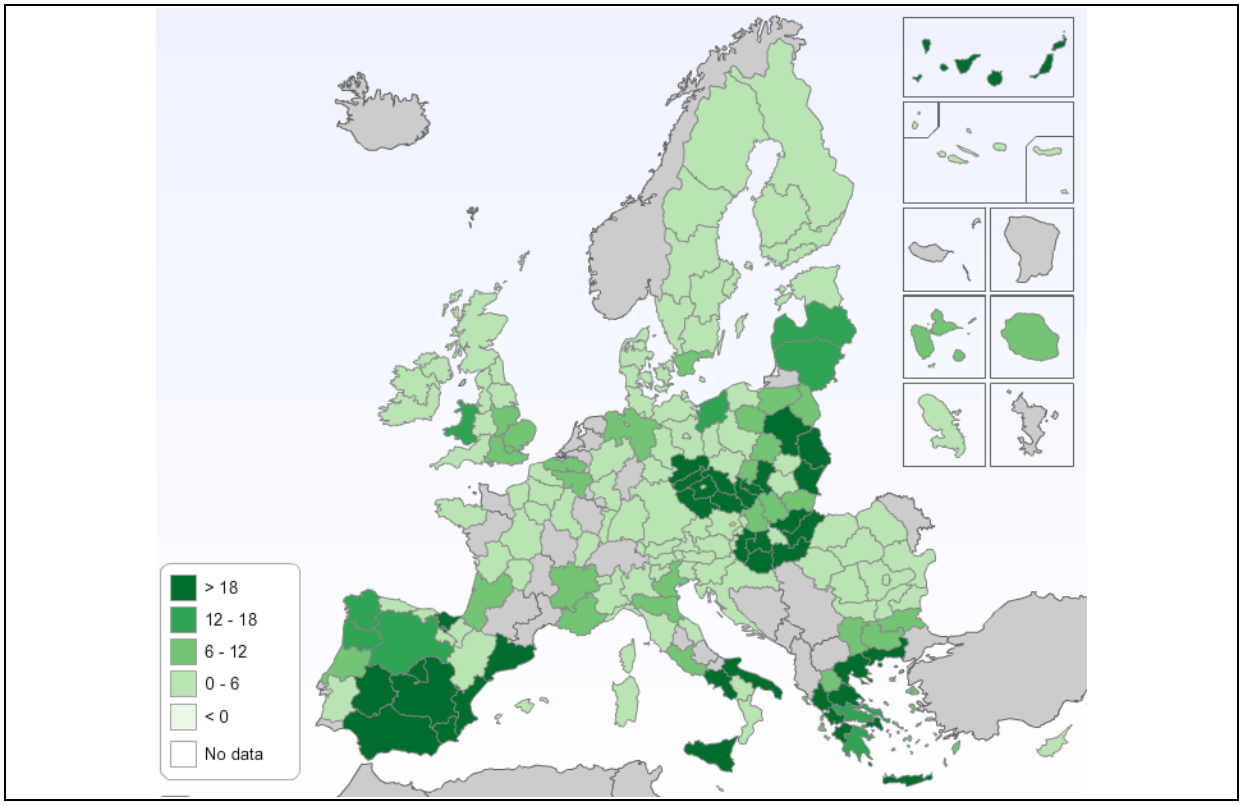
entrepreneurs and ICT start-ups); and 004, 'Productive investment linked to the cooperation between large enterprises and SMEs for developing ICT products and services, e-Commerce and enhancing demand for ICT'. These represent EUR 1.7 billion and EUR 304 million of planned investments, respectively, or EUR 2 billion in total. The amounts are coded under multi-TO (EUR 810 million), TO2 (EUR 790 million) and TO3 (EUR 349 million) and to a much lesser extent under TO1 and TO8.

Greece and Hungary figure more prominently than in previously described categories. The main investing countries are Greece (EUR 529 million), Spain (EUR 394 million), Hungary (EUR 265 million), Poland (EUR 191 million) and Italy (EUR 189 million). The main investing regions are Kentriki Makedonia (EL) (EUR 147 million), Andalucía (ES) (EUR 135 million), Attiki (EL) (EUR 106 million), Észak-Alföld (HU) (EUR 56 million) and Thessalia (EL) (EUR 55 million).

For keywords, the countries most frequently mentioning ICT SME support and e-Commerce in most categories are Italy (2 004 times) and Spain (1 065 times), followed by France (1 017 times), Greece (505 times) and Portugal (473 times), which mentions investment plans in ICT innovation. The regions most frequently mentioning ICT innovation keywords are all Italian: Puglia (418 times), Veneto (413 times), Calabria (399 times), Sicilia (386 times) and Sardegna (357 times).

The most common keywords are digital products, services and applications (mentioned 2 020 times), research and innovation (1 700 times), start-ups and venture capital, 1 241 times), innovation clusters, hubs and incubators (636 times) and vouchers (315 times).

Figure 9. ICT SME support and e-Commerce.



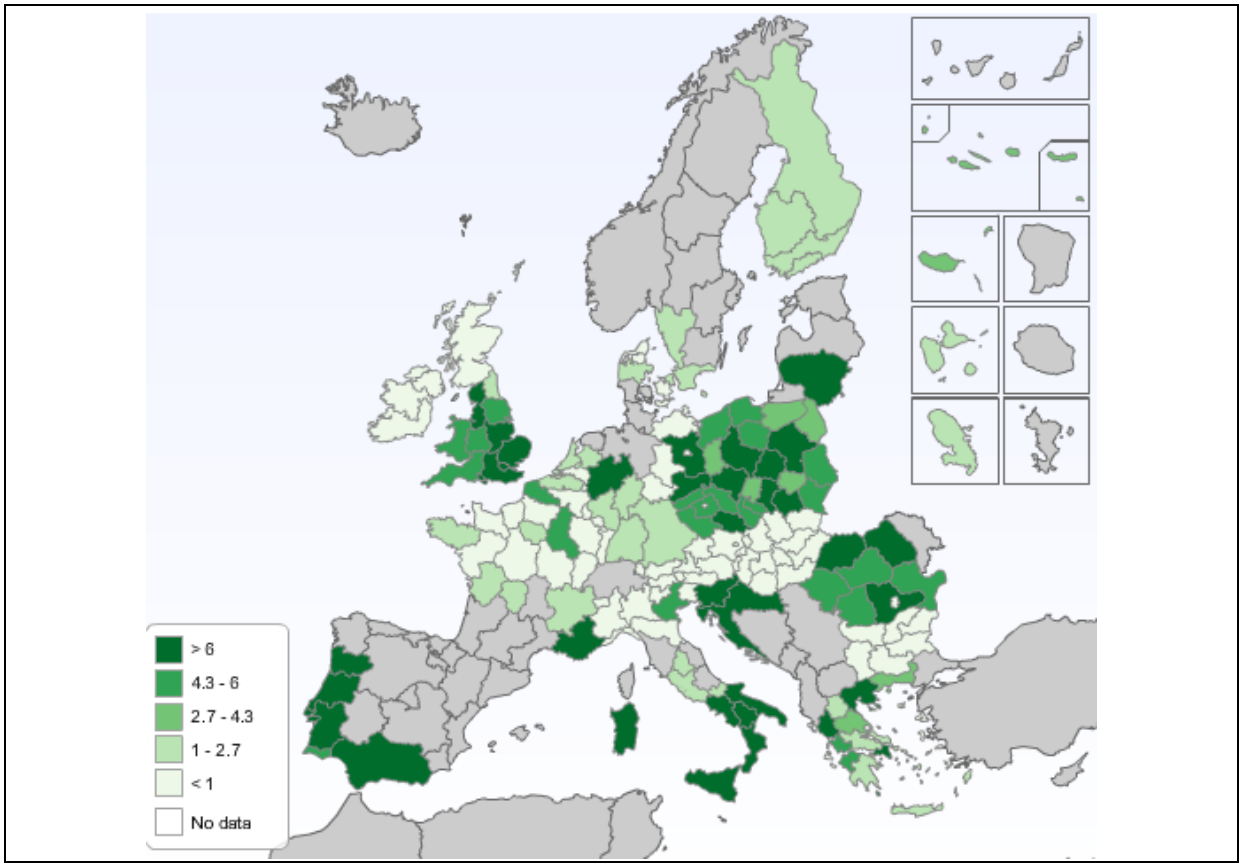
Source: ICT Monitoring tool and Infoview/SFC2014.

4.8 Smart grids and smart cities

For smart grids, the most relevant CoI is 015, 'Intelligent energy distribution systems at medium and low voltage levels' (including smart grids and ICT systems). Here there are planned investments of around EUR 1 billion, of which the majority (EUR 947 million) is planned under TO4 (low-carbon economy), followed by some investment (EUR 121 million) in multi-TO and a small amount in TO7 (sustainable transport).

The major investors are Italy (EUR 445 million), Portugal (EUR 120 million), Poland (EUR 103 million), the UK (EUR 89 million) and Germany (EUR 67 million). The main investors among the regions are southern Italian regions: Sicilia (EUR 149 million), Campania (EUR 143 million) and Puglia (EUR 77 million). However, two Portuguese regions also plan significant investment: Norte (EUR 42 million) and Lisboa (EUR 32 million).

Figure 10. Smart grids.



Source: ICT Monitoring tool and Infoview/SFC2014.

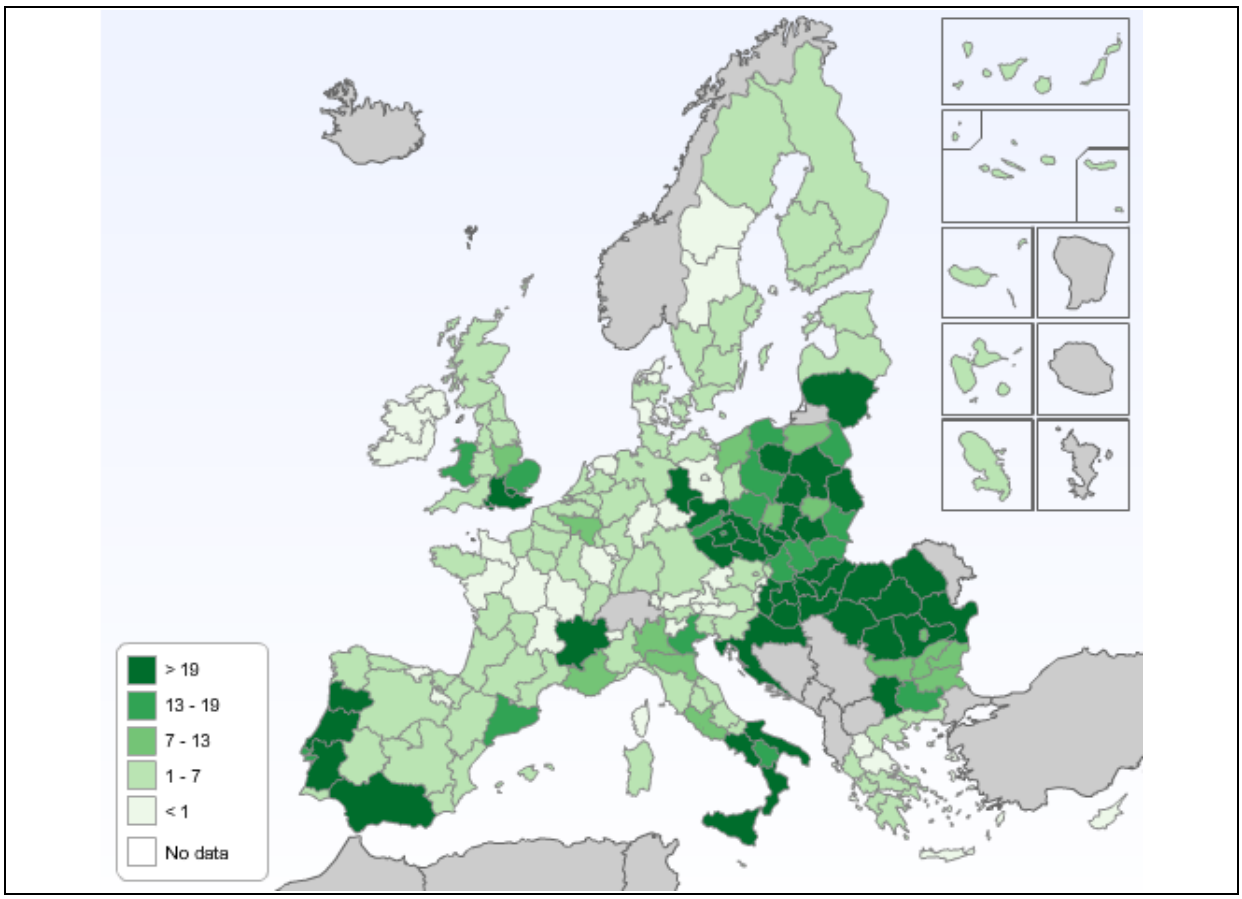
Investment under smart cities, is coded under 044, 'Intelligent transport systems' (including the introduction of demand management, tolling systems, IT monitoring, control and information systems). There are planned investments of EUR 2 billion, mainly in TO7 (transport) (EUR 845 million) TO4 (low-carbon economy) (EUR 695 million) and multi-TO (EUR 497 million) as well as some in TO1 and TO11.

The picture of the main investing countries is slightly different than in other ICT categories, as Hungary is the largest investor with EUR 325 million, followed by Poland (EUR 323 million) and Italy (EUR 298 million), with Romania (EUR 209 million) and the Czech Republic (EUR 172 million) also large investors. The regions with the largest planned investments are Campania (IT) (EUR 73 million), Közép-Magyarország (HU) (EUR 64 million), Sicilia (IT) (EUR 64 million), Slaskie (PL) (EUR 59 million) and Lietuva (LT) (EUR 58 million).

However, in terms of keywords use, the UK, Hungary and Romania are less prominent. The countries most frequently mentioning keywords relating to smart grids and smart cities are Italy (226 times), France (99 times), Spain (79 times), Poland (50 times) and Germany (33 times). Five Italian regions account for the most frequent use of keywords in this area: Puglia (67 times), Sardegna (52 times), Sicilia (48 times), Veneto (47 times) and Lombardia (43 times).

Among the keywords, smart cities, mobility and transport appear more frequently than smart grids and energy. The most commonly mentioned keywords are smart mobility (145 mentions), smart energy (97 mentions), smart cities (91 mentions), intelligent transport systems (87 mentions) and smart grids (57 mentions).

Figure 11. Smart cities.



Source: ICT Monitoring tool and Infoview/SFC2014.

4.9 Advanced computing, components and digital science

The three categories of advanced computing, components and digital science do not have any specific CoI, but they have their own predefined filters of keywords in the tool.

However, using some of the non-core CoIs that are research related and searching for them in all TOs can give a broader picture of investments in ICT (see Table 1 and Chapter 3). Here, an analysis of CoIs 049, 058, 059, 060, 061 has been undertaken. A rough estimate is that 10 % of these funds would go to ICT-related investments.

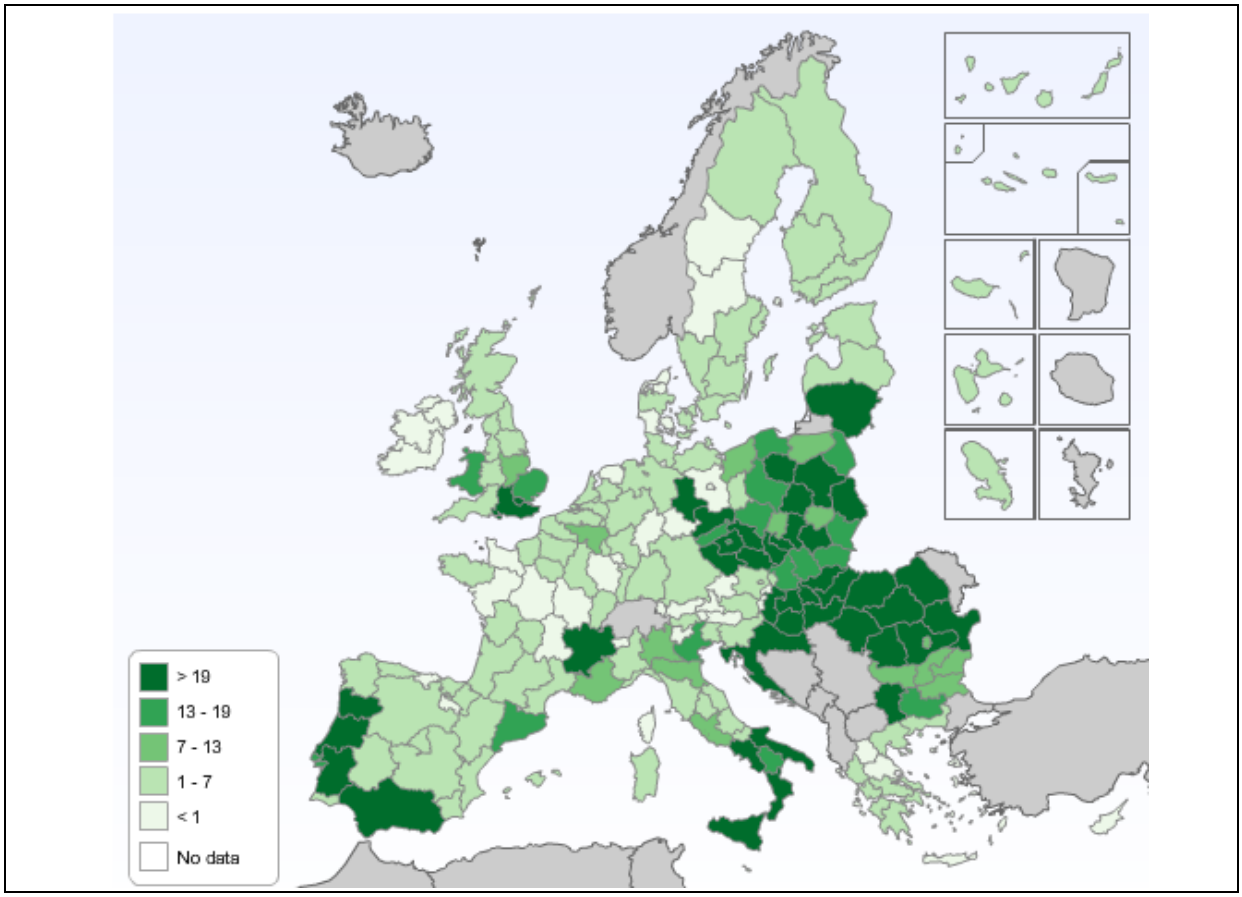
If this estimate of 10 % is correct, there will be investments of around EUR 1.6 billion in ICT-related R&I. The most important TO is TO1 (EUR 1.4 billion), followed by multi-TO (EUR 136 million), TO10 (EUR 105 million) and TO3 (EUR 18 million). There are minor investments coded under TO4, TO6, TO2, TO11 and TO8.

The countries with the largest investments in these categories are Spain (EUR 205 million), the Czech Republic (EUR 202 million), Poland (EUR 195 million), Germany (EUR 163 million) and Italy (EUR 111 million). The regions planning the largest investments include Andalucía (ES) (EUR 63 million), Hrvatska (HR) (EUR 52 million), Lietuva (LT) (EUR 44 million), Norte (PT) (EUR 40 million) and Latvija (LV) (EUR 38 million).

The keywords are divided in three activity areas: advanced computing, components and digital science. The activity area most frequently mentioned is components (764 times), followed by advanced computing (737 times) and digital science (479 times).

With regard to planned activities in advanced computing, Italy is the country that most frequently mentions related keywords (266 times), followed by France (88 times), Spain (72 times), Poland (68 times) and Slovakia (38 times). At the regional level, it is again Italian regions that most frequently use related keywords: Sicilia (77 times), Calabria (74 times), Campania (73 times), Puglia (70 times) and Basilicata (56 times). The most commonly mentioned keywords are cloud computing (233 times), computing (184 times), data analytics and database management (116 times), simulation and modelling (101 times) and complex and embedded systems (40 times).

Figure 12. Research and innovation.



Source: ICT Monitoring tool and Infoview/SFC2014.

For components, Italy is again the country where these keywords are most frequently mentioned (326 times), followed by France (152 times), Spain (77 times), Portugal (44 times) and Greece (30 times). The Italian regions dominate the top five once more: Sicilia (64 times), Campania (63 times), Puglia (61 times), Molise (61 times) and Sardegna (57 times). The most commonly mentioned keywords are optics (mentioned

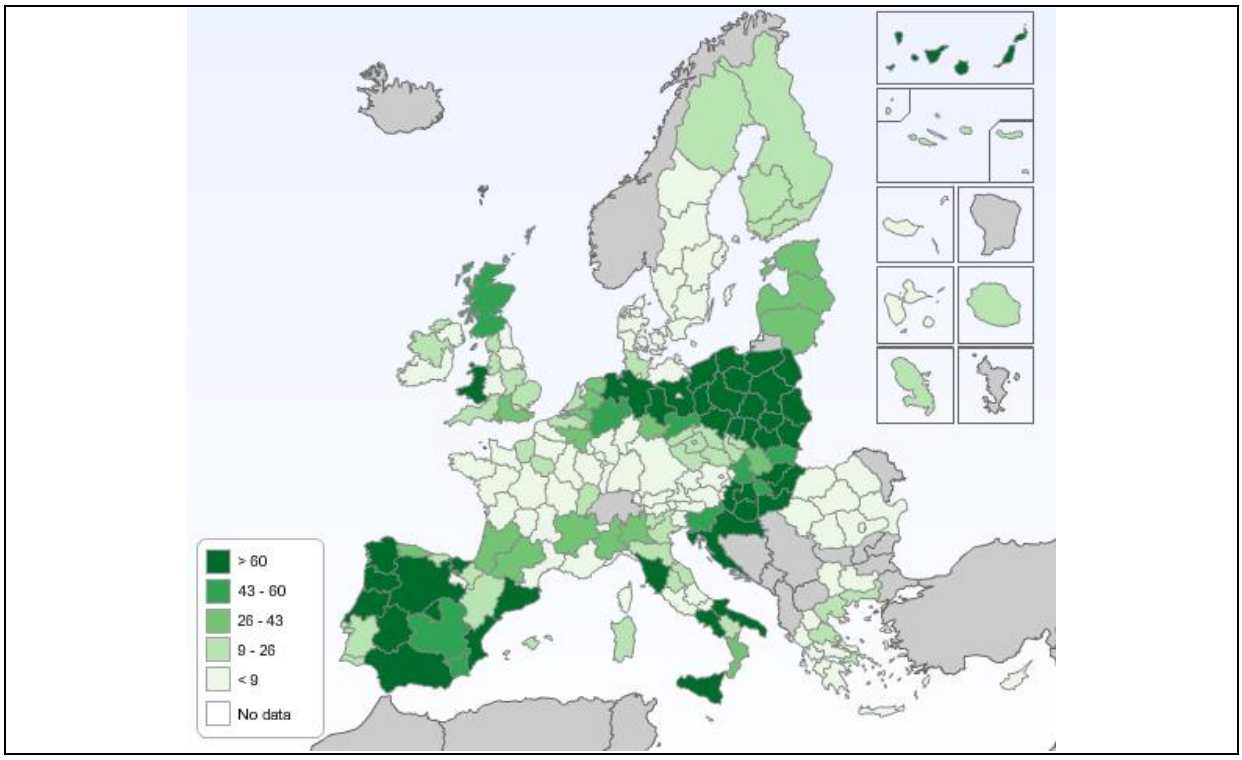
150 times), microsystem (125 times), KETs (117 times), microelectronics (100 times), and hardware (81 times).

For the activity area of digital science, it is Italy which mentions related keywords most frequently (154 times), followed by Spain (70 times), France (61 times), the UK (34 times) and Poland (32 times). It is also the Italian regions that most frequently mention these keywords: Puglia (52 times), Calabria (48 times), Molise (46 times), Sicilia (45 times) and Sardegna (44 times). The most frequently mentioned keywords are ICT research (226 times), open data (110 times), open access (51 times), digital science (36 times) and big data (35 times).

4.10 Innovation vouchers

During the development of this tool there was much discussion concerning the need to use different kinds of financial instruments in the delivery of the ESIF; of particular interest was the use of innovation vouchers. In developing the tool, therefore, a few different categories related to innovation vouchers have been included, despite their lack of direct relation to ICT. The primary CoI, 064, 'Research and innovation processes in SMEs' (including voucher schemes, process, design, service and social innovation), is only marginally encoded under TO2; out of the EUR 8.8 billion planned for this category, only EUR 2 million is coded under TO2, by one region, Provence Alpes Côte d'Azur (FR).[11] The majority of planned investment is under TO1 (EUR 6.9 billion), multi-TO (EUR 1.1 billion) and TO3 (EUR 813 million. However, as we have previously described for other ICT investments under TO1 and TO3, it is possible that ICT activities are being funded in a larger proportion than the sum of EUR 2 million indicates.

Figure 13. Innovation vouchers (064) in all thematic objectives.



Source: ICT Monitoring tool and Infoview/SFC2014.

11 Provence Alpes Côte d'Azur is planning to invest in ICT related vouchers also in CoI 066. In 064 it is innovation vouchers which are related to spin offs from academia and 066 for business related R&I.

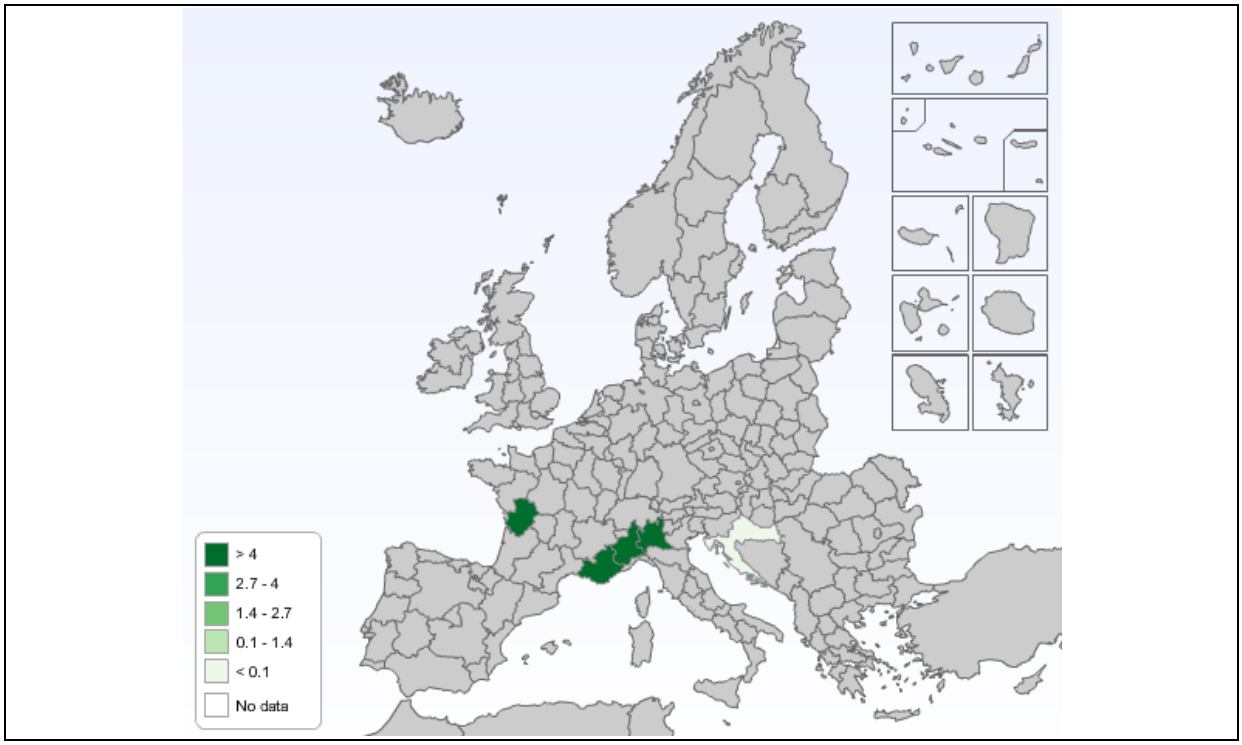
The countries with the largest planned investments under CoI 064 are Poland (EUR 3.4 billion), Spain (EUR 1.3 billion), Hungary (EUR 1.2 billion), Italy (EUR 626 million) and Germany (EUR 469 million). The largest regional investments will be in Poland: Slaskie (PL), EUR 371 million; Mazowieckie (EUR 289 million), Wielkopolskie (EUR 277 million), Malopolskie (EUR 275 million) and Podkarpackie (EUR 274 million).

Another source of information is financial forms that regions and MSs will use in financing their activities. For financial instruments 03–06,[12] which are of a more revolving character, there are planned investments of EUR 20 billion. These investments are mainly coded in TO3 (SME support) (EUR 7.4 billion), followed by multi-TO (EUR 6 billion), TO4 (EUR 3 billion), TO1 (EUR 2.1 billion), TO8 (EUR 534 million), TO6 (EUR 446 million), TO9 (EUR 363 million), TO7 (EUR 52 million) TO2 (EUR 34 million), TO10, EUR 25 million and TO11 (EUR 8 million).

The country that will use this form of financing the most is Poland, which plans to invest EUR 3.7 billion in this way, followed by Portugal (EUR 2.6 billion), Hungary (EUR 2.4 billion), Italy (EUR 2.1 billion) and Germany (EUR 1.2 billion). Among the regions the largest investments are being planned by two Portuguese regions, Norte (EUR 1.1 billion) and Centro (EUR 745 million), followed by Lietuva (LT) (EUR 729 million), Hrvatska (HR) (EUR 622 million) and Észak-Alföld (HU) (EUR 494 million).

When it comes to ICT specifically, the numbers are very low: France plans to invest EUR 20 million, Italy EU 14 million and Croatia a tiny amount. This investment is being made in the two French regions of Poitou-Charentes (EUR 15 million) and Provence Alpes Côte d'Azur (EUR 5 million) and the two Italian regions of Lombardia (EUR 10 million) and Piemonte (EUR 4 million).

Figure 14. Financial instruments in ICT.



Source: ICT monitoring tool and Infoview/SFC2014.

12 Financial instruments: 03: Support through financial instruments: venture and equity capital or equivalent; 04: Support through financial instruments: loan or equivalent; 05: Support through financial instruments: guarantee or equivalent; 06: Support through financial instruments: interest rate subsidy, guarantee fee subsidy, technical support or equivalent.

When looking at vouchers and financial instruments from the amounts perspective, there seem to be few planned investments related to ICT; however, when looking at the keywords the picture changes slightly.

With regard to keywords, there are two relevant categories, one related to vouchers in general and one which specifically identifies ICT vouchers.

With regard to vouchers with no ICT connection, Italy comes out top, mentioning these keywords 173 times, followed by Greece (32 times), Portugal (25 times), the UK (19 times) and Poland (16 times). Italy also accounts for the top regions, which are Calabria (22 times), Basilicata (19 times), Lombardia (19 times), Piemonte (19 times) and Campania (19 times). When it comes to ICT vouchers specifically, Italy is again the country mentioning these keywords most frequently, (27 times), this time followed by the UK (19 times), France (13 times), Ireland (10 times) and Greece (eight times). The regions most frequently keywords relating to vouchers with no ICT connection are Wales (UK) (10 times), Scotland (UK) (seven times), Puglia (IT) (seven times), Ipeiros (EL) (seven times) and Hrvatska (HR) (seven times).

Taking these data on vouchers into account, the countries with the largest planned investments are Poland, Portugal, Spain, Hungary, Italy and Germany. The countries opting for vouchers connected to ICT are France, Italy and Croatia. However, from the keyword analysis, it is likely that more countries and regions will use vouchers for ICT investments; all 28 MSs mention ICT vouchers in an OP and 209 regions are covered by an OP that mentions this planned activity. So it seems likely that there will be more investments in ICT using vouchers than is indicated by CoI 064 in TO2 or the financial instruments in TO2. Thus, it is likely that voucher schemes that will also invest in ICT will be coded in TO3, multi-TO, TO4 or TO1.

5. Conclusions and recommendations for the future of the tool

5.1 Summary

The ESIF monitoring tool displays planned investments in ICT under the ERDF, ESF, CF, YEI and EAFRD funds. It depicts investment areas related to ICT and breaks down the data at a regional level. It can be searched using a number of predefined filters, or users can create customised searches of TOs and CoIs. The tool also contains a database of keywords built up by a semantic search for keywords in OPs. This database allows the user to identify which OPs mention a number of ICT activities more frequently than others, and to determine if a specific topic is mentioned in a region.

The data set included in the tool is based on a study of the structures of OPs and of which categories of data are most relevant, as well as interactions with DG CONNECT staff[13] in charge of different thematic ICT areas.

Analysis of the data showed that TO2 alone cannot account for all planned ESIF investments in ICT, and that ICT spending goes beyond this. The study also explored a number of core CoIs in ICT and non-core CoIs; by including these, planned investment in ICT almost doubled (the proportion of the combined total of ERDF, ESF, CF and EAFRD going to ICT rises from 3.8 % to around 6.6 %). However, it seems that even this figure does not capture all planned investments, as respondents in our study indicated that substantial investments in ICT are included in other categories. This reflects the dual nature of ICT as both an important sector and activity in itself and a technology enabling other public and private activities.

In this report, taking a narrow view (including TO2 and EAFRD in ICT), we estimate a minimum ICT investment of EUR 12.2 billion investment. Taking a moderate view (including core and non-core CoIs in ICT, ESF and EAFRD in ICT) results in a figure a EUR 21.4 billion for ICT investment. Adopting a broad view that includes the same categories but in addition 10 % of a number of other relevant CoIs for e-Government, e-Health, digital content, digital skills, SME support, and R&I, the amount would rise to EUR 35.5 billion. As the estimates in the latter category are not based on sufficiently accurate methods, we have abstained from including this perspective in the online tool.

Based on the highest estimates, the MSs that plan by far the largest investments in ICT in absolute terms are Poland, Italy and Spain, with substantial investments by Hungary, France, the Czech Republic, Greece, Slovakia and Romania. The regions with the largest planned investments are Campania (IT), Sicilia (IT), Andalucía (ES), Slaskie (PL), Puglia (IT), Malopolskie (PL) and Západné Slovensko (SK). For example, the region of Campania plans to invest more ESIF in ICT than Germany.

Most investments will go to broadband and ICT infrastructures (EUR 6.9 billion), e-Inclusion and digital skills (EUR 3.9 billion), e-Government (EUR 3.4 billion) and smart cities and smart grids (EUR 3.1 billion).

Furthermore, the categories described above are quite often very broad and include many interesting activities. Therefore, to obtain a more in-depth view of what is planned in regions with regard to more specific ICT topics, a keyword study was carried out. The 'Actions to be supported' sections of OPs (not for the EAFRD) were searched for a number of keywords grouped in different activity areas. The keyword search helped to identify which OPs focus on which specific topics and provided an overview of the topics that regions consider important. It also revealed, to some extent, the relative importance of different topics.

[13] DG CONNECT staff is one of the primary user groups for the tool.

Among the keywords, the most frequently mentioned activity areas are ICT innovation, e-Inclusion, broadband and digital content. This is partly because these keywords for innovation are broad and all encompassing, but the finding also reflects an ambition among regions to invest in ICT-based innovation activities. Quite substantial ICT investments will go to ICT-based innovation and digital content, but under CoIs related to SME support and R&I, rather than the core CoIs for planned ICT investments.

5.2 Recommendations for future developments

There are a few improvements that could be carried out to improve the tool. These relate to the current data set of CoIs, additional data sets from other funds and periods in time, as well as to data sets covering innovation and digital capability and new functions.

To capture the broader view of planned ICT investments, the additional CoIs mentioned in Chapter 3 could be added to the tool. Potentially, a filter could be included to capture the additional parts of other planned investment that is related to ICT. However, in this case, what the final estimate should be would require to be confirmed by further analysis. A predefined filter could also be included to capture amounts related to digital science, computing and components.

With regard to the keywords, Italian regions often came out top in searches, followed most often by Polish regions. Although Italian regions will make substantial investments in ICT, Poland will invest more. It is possible that the language used in the OPs, the number of OPs and the structure of the OPs in the different countries might affect the frequency with which keywords are mentioned. One measure to overcome these shortcomings and enable a fair comparison of MSs could be to introduce a relative measure, e.g. how often a word is mentioned as a proportion of the total number of words in the OP sections on actions to be supported.

Likewise, it could be of interest to have a relative measure for planned investments that would illustrate the size of the planned investment in the region compared with total amounts available to the region.

In countries where there are many national and multi-national programmes, as well as transborder collaboration programmes, such as Italy, the identified keywords are attributed to all regions, and, as a result, these regions appear at the top of the list in the regional rankings. It could be useful to have a function whereby it would be possible to select or deselect different forms of OPs, i.e. to choose whether to include regional, multi-regional, national and transborder collaboration programmes in the search.

The tool would benefit from a new map function, particularly if additional data sets are to be added, in which case it would be of great interest to simultaneously show a number of different indicators. It would also be beneficial to have a map tool that would allow the user to use the map for searches in a more interactive way.

There are a number of additional data sets that could be added to the tool to strengthen it. The most useful could be to incorporate actual spending once regions and MSs start implementing their OPs. This would allow the tool to serve as an early warning system that could indicate discrepancies between planned and actual investments.

It might also be possible to add data from other EU funding sources for planned ICT investments, for example FP7/H2020, EFSI, COSME and EMFF. Another addition could be to add more historic data to track development over time of planned and actual investments in these funds.

Another interesting development would be to include indicators on ICT innovation capabilities such as data on patents, employment and companies,[14] which could be further enhanced by data relating to different types of Digital Agenda for Europe (DAE) or the Digital Economy and Society Index (DESI) scoreboard indicators, and to relate these to implementation effects.

In the medium term, this tool could be further developed into a portal to data on ICT-based regional growth, thus building a bridge between ICT/digital agenda on one side and regional development on the other, increasing its relevance to stakeholders in both communities.

[14] A potentially fruitful approach would be to merge with data that are used in the EIPE project (see http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html).

Appendix 1. Categories of investment

The core CoIs are the those strongly correlated with ICT activities. The non-core CoIs are not strongly ICT correlated, but some regions have indicated that these have an ICT component by using these together with TO2, which does directly apply to ICT investments.

Main CoIs		Other CoIs	
004	Productive investment linked to the cooperation between large enterprises and SMEs for developing ICT products and services, e-Commerce and enhancing demand for ICT	049	Education infrastructure for tertiary education
015	Intelligent energy distribution systems at medium and low voltage levels (including smart grids and ICT systems)	056	Investment in infrastructure, capacities and equipment in SMEs directly linked to research and innovation activities
044	Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring, control and information systems)	058	Research and innovation infrastructures (public)
045	ICT: Backbone/backhaul network	059	Research and innovation infrastructures (private, including science parks)
046	ICT: High-Speed broadband network (access/local loop; ≥ 30 Mbps)	060	Research and innovation activities in public research centres and centres of competence including networking
047	ICT: Very high-speed broadband network (access/local loop; ≥ 100 Mbps)	061	Research and innovation activities in private research centres including networking
048	ICT: Other types of ICT infrastructure/large-scale computer resources/equipment (including e-Infrastructure, data centres and sensors; also where embedded in other infrastructure such as research facilities, environmental and social infrastructure)	062	Technology transfer and university–enterprise cooperation primarily benefiting SMEs
078	e-Government services and applications (including e-Procurement, ICT measures supporting the reform of public administration, cyber-security, trust and privacy measures, e-Justice and e-Democracy)	063	Cluster support and business networks primarily benefiting SMEs
079	Access to public sector information (including open data e-Culture, digital libraries, e-Content and e-Tourism)	064	Research and innovation processes in SMEs (including voucher schemes, process, design, service and social innovation)
080	e-Inclusion, e-Accessibility, e-Learning and e-Education services and applications, digital literacy	066	Advanced support services for SMEs and groups of SMEs (including management, marketing and design services)
081	ICT solutions addressing the healthy active ageing challenge and e-Health services and applications (including e-Care and ambient assisted living)	067	SME business development, support to entrepreneurship and incubation (including support to spin offs and spin outs)
082	ICT Services and applications for SMEs (including e-Commerce, e-Business and networked business processes), living labs, web entrepreneurs and ICT start-ups)	101	Cross-financing under the ERDF (support to ESF-type actions necessary for the satisfactory implementation of the ERDF part of the operation and directly linked to it)
05	ESF second theme: enhancing the accessibility, use and quality of information	107	Active and healthy ageing
		115	Reducing and preventing early school-leaving and promoting equal access to good quality early childhood, primary and secondary education including formal, non- formal and informal learning pathways for reintegrating into education and training
		116	Improving the quality and efficiency of, and access to, tertiary and equivalent education with a view to increasing participation and attainment levels, especially for disadvantaged groups
		117	Enhancing equal access to lifelong learning for all age groups in formal, non-formal and informal settings, upgrading the knowledge, skills and competences of the workforce, and promoting flexible learning pathways including through career guidance and validation of acquired competences
		118	Improving the labour market relevance of education and training systems, facilitating the transition from education to work, and strengthening vocational education and training systems and their quality, including through mechanisms for skills anticipation, adaptation of curricula and the establishment and development of work-based learning systems, including dual learning systems and apprenticeship schemes
		121	Preparation, implementation, monitoring and inspection

Appendix 2. Activity areas and keywords

Activity area	Keyword	Single terms	Combined terms: ICT, electronic, online, on-line, internet, web, data, DAE, digital, mobile, cyber, information system
Digital single market/digital agenda	Digital agenda	Digital agenda, DAE	
	Digital divide	Digital divide	
	Digital single market	Digital single market, DSM	
	Digital economy and Information society	Digital Economy, information society, digital society	
	Digital growth	Digital growth	
	ICT sector	ICT sector	
	ICT cluster	ICT cluster	Cluster
	ICT for agriculture		Agriculture
	ICT for manufacturing		Advanced manufacturing
	Connecting Europe facility	Connecting Europe facility, CEF	
	ICT and H2020		Horizon 2020, Horizon2020, H-2020, H2020
Components	Graphene	Graphene	
	Hardware	Hardware	
	Key enabling technologies	KETs, key enabling technology, key enabling technologies	
	Lasers	Laser, lasers	
	Microelectronics	Micro-electronic, micro-electronics, electronics, semi-conductor, lithograph, stepper	
	Microsystem	micro-system, microsystems, mems, integrated system, smart system, smart system integration, digital system, actuator	Sensor
	Nano electronics	Nano-electronics, nano-electronic, nano-tech, nano-technology, nano-technologies, nano-material	
	Optics	Optic, optics, opto	
	Organic electronic	Organic electronic, flexible electronic, stretchable electronic, printed electronic, Organic electronics, flexible electronics, stretchable electronics, printed electronics	
	Photonics	Photonic, photonics, photon, LED, SSL, OLED, OPV	Light, fibre, fiber
	Pilot lines		Pilot line
	Robotics	Robotic, automation, cognitive, autonomous driving, autonomous system, drone, UAV, Robot, unmanned vehicle, AI, intelligent agent, artificial intelligence	Cognition, UGV
Advanced computing	Advanced computing	Advanced computing, high-performance computing, HPC, distributed computing, grid computing	
	Low power computing	low-power computing, low-energy computing, low-power computer, low-energy computer	
	Cloud computing	Cloud, cloud services, cloud computing, cloud technologies, SAAS, saas, SaaS, IaaS, PaaS, cloud based data, cloud data	
	Computing	Computing, compute	
	Complex and embedded system	Complex system, embedded system, embedded software, cyber-physical system, model-based engineering	
	Data analytics and database management	data analytics, database management, information management systems, decision support, smart systems, smart data	
	Factory of the future	Factory of the future, additive manufacturing, laser-based manufacturing, 3D manufacturing, digitising industry, industrie 4.0, industry 4.0, digitalisation of industry	
	Internet of Things	Internet of things, smart objects, connected objects	Simulation, modeling, modelling
	Service architectures	Internet of services, Service architectures	
	Simulation and modelling	Simulation, modeling, modelling	
	Open source	Open-source	
	Software services and engineering	Software services, software engineering	
Digital science	Big data	Big data	
	Citizen science		Citizen science
	Digital science	Digital science	Science
	Flagships		Flagships, flagship
	Future and emerging Technologies	FET, Future and emerging technologies, Future and emerging technology	

	High performance computing and supercomputing	HPC, High-performance computing, Super-computing, terabyte, petabyte, exabyte, teraflop, petaflop, exaflop	terascale, petascale, exascale
	Human brain project	Human brain project, HBP	
	ICT and art		Art
	Open access	Open access, online access, public access	
	Open data	Open data	
	Open science	Open science	
	ICT research		Research
Broadband & digital networks	Broadband	Broadband, high-speed internet, satellite, Fibre, Fiber, NGN, NGA, next generation access, Next generation networks	High-speed
	Broadband and engineering projects		Engineering projects, infrastructure projects
	Data centres and storage	Data centres and storage	Data centre, storage
	e-Infrastructure and information systems	e-Infrastructure, future network, information system, information systems, ICT infrastructure, EGI, telecommunications network	Infrastructure, networks
	GÉANT and Networks for research	Networks for research, GEANT, GÉANT	Research networks
	Wireless	3G, 4G, 5G, LTE, base-stations, wireless, long-term evolution	
ICT innovation	Digital service infrastructures	Digital service infrastructures	
	Innovation clusters, hubs and incubators	Hub, hubs, innovation clusters, innovation ecosystem, incubators, innovation cluster, innovation ecosystems, incubator	Cluster, clusters
	Experimental platforms	Living lab, living labs, experimental platform, experimental platforms, test bed, Test-beds, demonstration facilities, open & agile, open and agile, fab lab	Experimentation, demonstration
	Innovation procurement	Innovation procurement, pre-commercial procurement, innovative procurement	
	Digital architectures	Digital social innovation, collective awareness, distributed architectures, distributed architecture	
	Open innovation in ICT		Open innovation
	Research and innovation		Innovation, research, development, R&D, R&I, technology transfer
	Cross-border collaboration and value-chains in ICT		value-chain, cross-border cooperation , cross-border networking
	Service innovation	Service innovation	
	Social innovation	Social innovation	
	Service innovation in ICT		Service innovation
	Social innovation in ICT		Social innovation
	SME support	On-line advice, on-line counselling, digital eco-system, SME support	SME, counselling, advisory services
	Start-ups and venture capital	Venture capital, business angels, accelerators, access to finance, Start-Ups, Entrepreneurs, start-up, entrepreneurial skills	
	Vouchers	Voucher, vouchers, technology implementation, cheque	
	ICT start-ups and venture capital		Venture capital, business angels, accelerators, access to finance, Start-Ups, Entrepreneurs, start-up, entrepreneurial skills
	ICT vouchers		Voucher, vouchers, technology implementation, cheque
Digital content, creative industries and digitisation of culture	Augmented and virtual reality	Augmented reality, AR, virtual reality	
	Creativity and design		Creative, creativity, design
	e-Culture and digital culture	e-Culture, digitalisation of culture	Culture, cultural
	Cultural heritage		Cultural heritage
	Cultural preservation	Preservation of culture, cultural preservation	Preservation
	Digital content & media	e-Content	Content, media
	Digital collections, libraries, archives, museums	Digital libraries, Digital library, virtual museum, digital collections	Libraries, Library, archives, museums, archive, museum
	Digitisation	Digitisation	
	Europeana	Europeana	
	Games & gamification	Gamification	Game
	ICT & tourism	e-Tourism	Tourism

	Multilingual and semantic web	Machine translation	Semantic, multi-lingual
	Visualisation and simulation	Visualisation, simulation, virtualisation	
e-Inclusion	Grand coalition	Grand coalition	
	Internet access & accessibility	Internet access, e-accessibility, Web accessibility	Accessibility
	Jobs		Jobs
	Workforce		Workforce
	Digital skills and literacy	e-Skills, digital literacy, digital competence, digital competences, digital illiteracy, digitally illiterate, ICT Skills	Skills, competence, competencies
	Digital inclusion	e-Inclusion, digital inclusion	Inclusion
	e-Learning	e-Learning, digital learning, open learning, distance learning, learning technologies	Learning
	Training and education	e-Education, electronic education, open education, digital classroom	Training, education
e-Health	Active and healthy ageing	Active aging, AHA, active and healthy ageing, active ageing, medical adherence, AFE	Aging, ageing, early detection
	Electronic Health Records	EHR, digital health record, patient summary, electronic patient record, electronic medical record	Health record
	e-Health	e-Health	Health, care
	Health Information System	Patient data, medical data, health information, patient summary, health data, clinical data	health card
	Independent living	Independent living, assisted living, AAL, service robot	Smart home, age-friendly
	Integrated care	Integrated healthcare, integrated care, integrated health, co-ordinated care, comprehensive care, seamless care, transmural care	Care
	m-Health	m-Health, mobile health, health apps, health applications	
	Personalised medicine	Individual health data, medication adherence, personalised medicine, personal health system, personalised health-care, user-generated data	Diagnostic, diagnosis
	e-Prescription	e-prescription	Prescription
	Telemedicine and telemonitoring	Tele-medicin, tele-medicine, tele-health, tele-monitoring, tele-care	
e-Government	e-Democracy	electronic democracy , e-Democracy	
	e-Government	e-Government, public ICT solutions, systems of public administration, Public administration data	Government services, public services
	e-Invoicing	e-Invoice	Invoice, invoicing
	e-Land management	e-Land management	Land management
	e-Procurement	e-Procurement	Procurement
	e-Welfare	e-Welfare	welfare services
	Interoperability public data	Interoperability of public data, interoperability platforms	Interoperability
	Online payment	Mobile payment, online payment, electronic payment	Payment
	Open and big data	Open data, government data, big data	
	e-Justice	e-Justice, e-legislation, electronic filing	
Trust, security and authentication	Cybercrime and attacks	Cyber-crime, cyber-attack, cyberattack, e-crime	Crime
	Electronic identification	Electronic identification, e-IDAS, e-Identification, EID, authentication	
	Interoperability, interconnection		Inter-operability, inter-connection
	Privacy	Privacy	
	Secure infrastructures	Cyber incident, network security, information security	Key infrastructure, resilience, stability
	Security and data protection	Data protection	Secure, security
	Trust services	e-Signature, digital signature, electronic signature, electronic time stamp, e-Time stamp, electronic seals, e-Seals, electronic registered delivery, e-Registered delivery, electronically registered delivery, website authentication	Trust
Smart cities and smart grids	Smart cities	Smart city, smart cities, intelligent city, ICT in cities	Urban regeneration, city lighting, city heating, district heating, district lighting
	Smart grids	Smart grid	Distribution energy systems, Integrated energy

	Smart energy	intelligent metering systems, intelligent buildings, smart buildings, Smart energy management, smart lighting, smart houses, intelligent lighting, control systems for buildings, smart energy system	Energy efficiency, housing, buildings renovation, street lighting
	Green cars	Green cars, electric vehicles	
	Climate data systems	climate data systems	Climate data
	Intelligent transport systems	intelligent transport systems, intelligent traffic management systems, transport tele-matics	traffic management
	Smart mobility	Smart mobility, intelligent mobility	MOBILITY
	Data centres/Green ICT	Green ICT, green data centres	
	City planning	GIS, spatial data, geographic information systems, intelligent maps	City management, land management
	Smart resource efficiency	Smart resources efficiency, intelligent use of resources	Waste management, waste water management, resource management

Appendix 3, Interview respondents

- Croatia
  - Jan Sulik, Ministry of Economy
  - Stanka Crvik Orešković, Ministry for Regional Development and EU Funds
- Czech Republic
  - Petr Tůma, Ministry of Industry
  - Alice Sova, DG REGIO desk, Czech Republic
- France
  - Christine Loussert, Direction des Affaires Européennes, Région Provence Alpes Côte d'Azur
- Hungary
  - Csaba Kelemen, Head of Department, Ministry of National Development
- Italy
  - Bertini Silvano, Regione Emilia-Romagna
  - Gaetano Grasso, Innova Puglia, Puglia Region
  - Francesca Michielin, DG REGIO desk, Italy
- Poland
  - Mateusz Golanski, Departament Rozwoju Cyfrowego, Ministerstwo Infrastruktury i Rozwoju
  - Katarzyna Kaczkowska, Head of Unit, Departament Konkurencyjności i Innowacyjności, Ministerstwo Infrastruktury i Rozwoju
  - Małgorzata Zakrzewska, Deputy Director, Lodz
- Spain
  - Adolfina Martinez, Junta de Andalucia

Appendix 4. Examples of interventions to be supported

These examples of activities that will be supported under the different CoIs come mainly from interviews carried out in the process of the quality review. As we were unable to make contact with some of the regions, the specific OPs were reviewed instead. This was carried out for Greece and the OP for public sector reform (CoI 096), Île de France (CoI 049 and 065), as well as for ESF 05, the Malopolska regional OP, the Portuguese OP on competitiveness and Bulgarian OP on human resources development.

Category of Intervention	Examples of activities to be supported
004: Productive investment linked to the cooperation between large enterprises and SMEs for developing ICT products and services, e-Commerce and enhancing demand for ICT	• e-Commerce and enhancing demand for ICT (CZ) • Motivation and awareness activities (events, campaigns, consultancy) raising SME ICT readiness and introduction of new business ICT applications and solutions (ERP, CRM, cloud, etc.) for SMEs (HU)
015: Intelligent energy distribution systems at medium and low voltage levels (including smart grids and ICT systems)	• Smart metering and grid developments (HU) • Installation of smart metering devices, provision of accurate feedback about end-use energy consumption, introduction of home energy management systems, including various wireless communications options (for smart metering) which will contribute to the specific objective by allowing users to manage and use energy sources more carefully and efficiently and less costly (HR) • ICT for smart electricity grids, smart meters, smart distribution systems (Andalucia) • Energy efficiency and Smart housing (Provence Alpes Côte d'Azur)
044: Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring, control and information systems)	• Intelligent transport system developments (HU) • Implementation of systems for monitoring and management of transport systems (ITS) within urban areas (HR) • Actions enhancing services of railway transport to users (e-Services, single ticketing, station and onboard (in train) information systems), reintegration of railways within existing urban transport systems (operations synchronization, joint/aligned timetables with urban transport) (HR)
045: ICT, backbone/backhaul network	• Financing development of aggregation (backhaul) (HR) • NGN networks and connection of public institutions to NGN network (HR) • Financing development of NGN/NGA networks in NGA white areas (HR)
046: ICT, high-speed broadband network (access/local loop; ≥ 30 Mbps)	• Development of local and backhaul new generation broadband networks in 'white spots' (HU) • Development of state broadband networks and access of institutions (HU) • NGN networks and connection of public institutions to NGN network and financing development of NGN/NGA networks in NGA white areas (HR) • High speed broadband guaranteeing universal coverage (Andalucía)
047: ICT, very high-speed broadband network (access/local loop; ≥ 100 Mbps)	• High speed broadband guaranteeing universal coverage (Andalucía)
048: ICT: Other types of ICT infrastructure/large-scale computer resources/equipment (including e-infrastructure, data centres and sensors; also where embedded in other infrastructure such as research facilities, environmental and social infrastructure)	• Activity data centres and shared services centres (CZ) • Development of governmental broadband networks (HU) • Establishment of the government cloud (HR) • Large-scale procurement of ICT equipment for primary and secondary schools (procurement of ICT equipment for teaching and learning, namely for teachers and for classrooms) (HR) • Equipping primary and secondary schools with appropriate LANs (constructing local internet networks in schools (targeted school locations) (HR) • Deployed data centres ready to absorb the increased demand for e-Service and e-Content in the school cloud (HR) • ICT, specialised didactical and pedagogical equipment, transformation and refurbishment of the premises, joint facilities shared by VET schools and companies/local communities/centres of competences (HR)

078: e-Government services and applications (including e-procurement, ICT measures supporting the reform of public administration, cyber-security, trust and privacy measures, e-Justice and e-Democracy)	• e-Health (PL) • e-Government developments, e.g. public administration and Civil Service Development Operational Programme (PADOP) (HU) • e-Government, public administration (both to provide better services to citizens and internal organisation) (Andalucía) • e-Justice, to put judges online and connect them (Andalucia) • Environment ICT (Andalucia) • Consumer protection (Andalucia) • Digital trust (Andalucia) • Smart city (Andalucia) • e-Land management (HR) • e-Justice (HR) • e-Tourism (HR) • e-Inclusion (HR) • Public ICT projects, e-Government, e-Public services (HR) • Interoperability (HR) • Common identification and authentication interface (HR) • e-Citizens email (HR) • Cyber security (Provence Alpes Côte d'Azur)
079: Access to public sector information (including open data e-Culture, digital libraries, e-Content and e-Tourism)	• Living labs (Emilia Romagna) • Network projects for innovation services (Emilia Romagna) • Start-ups in ICT and Knowledge intensive services (Emilia Romagna) • e-Culture (HR) • Open data and big data (Andalucía) • Digital content (Andalucía) • New ways of accessing culture festivals and community building (Provence Alpes Côte d'Azur)
080: e-Inclusion, e-Accessibility, e-Learning and e-Education services and applications, digital literacy	• Development of services and infrastructure of community internet access points (HU) • Motivation and awareness raising activities (events, campaigns) for e-Inclusion of lagging social groups (HU) • e-Education developments (HU) • e-Education (Andalucía) • Telecentres in remote areas, access to internet and ICT training (Andalucía) • Digital skills, e-Learning and e-Inclusion (PL)
081: ICT solutions addressing the healthy active ageing challenge and e-Health services and applications (including e-Care and ambient assisted living)	• e-Health (HU) • Connecting hospitals- project, EUROSTAR (Andalucía) • e-Health (HR) • ICT services and applications for health, SMEs in area of health, Domotic services (Provence Alpes Côte d'Azur)
082: ICT Services and applications for SMEs (including e-Commerce, e-Business and networked business processes), living labs, web entrepreneurs and ICT start-ups)	• Support the creation of new sophisticated ICT solutions (CZ) • Cooperation between ICT firms and educational institutions via motivation and communication campaigns, events, workshops, business consulting (HU) • Commercialization and international marketization of ICT products and services (consulting, promotion, marketing, tender and expo participation, software localization) (HU) • Support SMEs in production of new applications and services, such as smart connected objects (Provence Alpes Côte d'Azur) • Energy efficiency and Smart housing (Provence Alpes Côte d'Azur) • Cyber security (Provence Alpes Côte d'Azur) • ICT services and applications for health, SMEs in area of health, Domotic services (Provence Alpes Côte d'Azur)
05: ESF second theme: enhancing the accessibility, use and quality of information	• Provision of intermediary services (BG) • Provision of on-the-job training (BG) • Provision of trainings for SME managers and entrepreneurs in order to improve their managerial and entrepreneurial skills (BG) • Equipment and workplace adaptation (BG) • The specific training program comprising two parts: a general basic training in order to standardize the level of knowledge in transversal issues to the public administration and specific training geared to meet the specific needs of recruitment; the actions that are part of the program is face to face training system and/or distance (PT)
049: Education infrastructure for tertiary education	• ICT in education (HR) • ICT in vocational education and training (VET) (HR) • Data centres ready to absorb the increased demand for e-Service and e-Content in the school cloud (HR)

	• Equipping primary and secondary schools with appropriate LANs (constructing local internet networks in schools (targeted school locations) (HR) • Support to implementation of national e-Schools project (HR) • Support for creating projects, development and dissemination of tools, services and digital content, particularly in strategic areas S3 (Île de France) • Supporting new collaborative working methods based on digital technologies (telecentres, remote work spaces coworking, fablabs, Medialabs) (Île De France)
056: Investment in infrastructure, capacities and equipment in SMEs directly linked to research and innovation activities	• Ecosystem-strengthening innovative companies in the digital (web, e-Commerce, internet and digital media, etc.); to help their development, including the establishment of acceleration programs to the targeted market of digital companies and specific tools (incubation, seed financing, project accelerator, support for growth, etc.), related in particular with the national initiative FrenchTech (Provence Alpes Côte d'Azur) • Investments into R&D&I infrastructure (RIS) (HR) • ICT-based e-Infrastructures (HR) • ICT and Engineering (HR)
058: Research and innovation infrastructures (public)	• Creation and consolidation of ICT infrastructures to support the growth in areas of strategic interest to Andalucia, for example the digital economy, blue and green economies, agrofood, knowledge transfer and application in preferential socio economic areas (Andalucia) • Distributed e-Infrastructures for shared services of a pan European character (Andalucia) • Mobilisation of knowledge and technology transfer from research institutions into practice (SK) • Research and development information system / access to databases for the purposes of research institutions (SK) • Horizontal ICT support and central infrastructure for research and development institutions (SK) • Investments into R&D&I infrastructure (HR) • Make Provence Alpes Côte d'Azur an experimental ground for innovation and the uses of digital technology, support for experimental projects for new digital uses (PACAlabs) and establishment of practice demonstrators and places of uses of innovations (from 'Living Labs' territorial and thematic 'Fablabs' etc.) (Provence Alpes Côte d'Azur)
059: Research and innovation infrastructures (private, including science parks)	• Strengthening territorial digital ecosystems on relevant territories in the region, particularly in connection with the initiative national FrenchTech (Provence Alpes Côte d'Azur) • ICT-based e-Infrastructures (HR)
060: Research and innovation activities in public research centres and centres of competence including networking	• Key enabling technologies (KETs) – microelectronics, nano-electronics and photonics (Andaluca) • Implementation of structural platforms and innovation projects focused on 'key technologies of digital' that are strategic for Provence Alpes Côte d'Azur, (in particular: technologies without contacts, Internet of Things, M2M networks and mobile services, Very mobile broadband security and digital identity, supercomputing and simulation, cloud computing, 3D technologies, big data processing and data visualization, GIS, transmedia (Provence Alpes Côte d'Azur)
061: Research and innovation activities in private research centres including networking	• To promote the 'digital transformation' of companies with projects such as: studies and diagnostics; collective action and partnership operations of appropriation of digital technologies by businesses (in particular SOHO SMEs) (Provence Alpes Côte d'Azur)
062: Technology transfer and university-enterprise cooperation primarily benefiting SMEs	• Mobilisation of knowledge and technology transfer from research institutions into practice (SK) • To support the development of a campus for the area of Smart Cities connecting R&D with SMEs (Provence Alpes Côte d'Azur)
063: Cluster support and business networks primarily benefiting SMEs	• Shared platforms resources cloud computing (cloud) to the SOHO/SME; platforms federative of online commerce (including ESS, crafts, agriculture and promotion of local products) (Provence Alpes Côte d'Azur) • Projects aimed at dissemination of digital technologies and connected objects in industrial clusters, e.g. in traceability industry (Provence Alpes Côte d'Azur)
064: Research and innovation processes in SMEs (including	• ICT innovation vouchers for R&I organisations (Provence Alpes Côte d'Azur)

voucher schemes, process, design, service and social innovation)	• e-business (HR) • Optimising the business processes using ICT (HR) • Digitalisation of business services and products (HR)
065: Research and innovation infrastructure, processes, technology transfer and cooperation in enterprises focusing on the low carbon economy and on resilience to climate change	• Collective action to support the growth of SMEs in the sector S3 in terms of financing of ecological and social conversion, and link large group/SMEs (Île de France)
066: Advanced support services for SMEs and groups of SMEs (including management, marketing and design services)	• ICT innovation vouchers for applications beyond R&I (Provence Alpes Côte d'Azur) • Establishment of practice demonstrators and places of uses of innovations (from 'Living Labs' territorial and thematic Fablabs etc.) (Provence Alpes Côte d'Azur) • Use of e-Business tools by SMEs (SK) • ICT solutions for greater SME efficiency (HR) • ICT uptake (HR) • e-Services creation and provision between enterprises (B2B) (HR) • digitalisation of business services and products (HR)
067: SME business development, support to entrepreneurship and incubation (including support to spin offs and spin outs)	• Support to management of ICT processes (Andalucia) • Supporting the uptake of ICT in SMEs (Andalucia) • Tools for promotion and online commercialisation and the use of social networks (Andalucia)
071: Development and promotion of enterprises specialised in providing services contributing to the low carbon economy and to resilience to climate change (including support to such services)	• Product development and innovation projects (including innovative platforms) of digital services. e.g. in the area of risk prevention companies providing services and education on risk in flooding, earth quake, climate change (Provence Alpes Côte d'Azur)
096: Institutional capacity of public administrations and public services related to implementation of the ERDF or actions supporting ESF institutional capacity initiatives	• Strengthening organisational, institutional and operational capacity of public administration and local authorities for the benefit of citizens and businesses (GR) • Promotion of e-Government in the public sector (GR) • Development of human resources in the public sector, through the rational allocation of human resources, the provision of upgraded services, and training (GR) • The development of ICT systems and applications that are directly associated with the handling of internal processes and functions of public bodies e.g. infrastructure development, systems and applications • Improve the functioning of public services by upgrading their communication by providing advanced telematic services at low cost, and the unified civil service, with automated and user-friendly information systems and processing transactions with the State
101: Cross-financing under the ERDF (support to ESF-type actions necessary for the satisfactory implementation of the ERDF part of the operation and directly linked to it)	• Cross-financing is planned for training on the operation and use of the established communication and information systems for e-Government and open government; this will concern projects aiming at building e-Administration and training will mostly be provided for beneficiary's staff and employees of public administration institutions (PL)
121: Preparation, implementation, monitoring and inspection	• Secure that broadband investments development are focused, among other on those areas where they can benefit public administration institutions the best • Development of digital educational materials, tools and methods as well as organizational models supporting their use on a national level • Smart public administration

List of figures

List of tables

LF-NA-27983-EN-N

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Publications Office

doi:10.2791/963062

ISBN 978-92-79-59748-0